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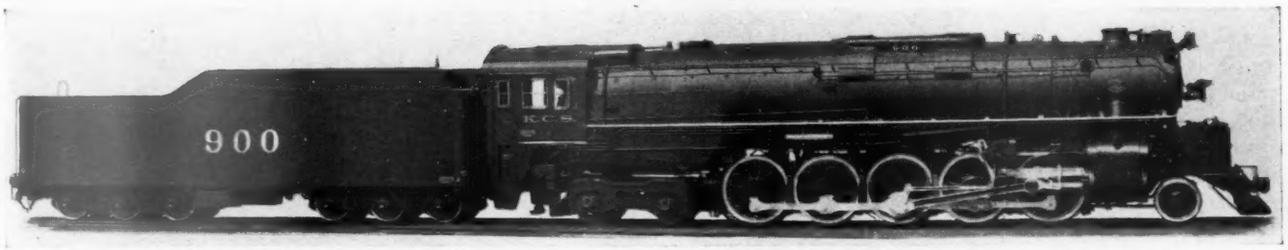
1912-1937

A QUARTER OF A CENTURY OF SERVICE
TO THE MAJORITY OF CLASS I RAILROADS



One of the oil-burning 2-10-4 type locomotives built by the Lima Locomotive Works, Inc., for the Kansas City Southern

Kansas City Southern

Freight Locomotives

Ten 2-10-4 type built by Lima develop a tractive force of 93,300 lb.—The boiler pressure is 310 lb. and there are 7,229 sq. ft. of combined heating surface—Five burn oil and five burn coal

THE Kansas City Southern received ten freight locomotives of the 2-10-4 type from the Lima Locomotive Works during the latter part of the summer, five of which were equipped for burning oil and five for burning coal. Neither in point of total weight, weight on drivers, nor combined heating surface are these locomotives the largest which have been built. The cylinder tractive force of 93,300 lb., however, has not been exceeded, and their boiler pressure of 310 lb. is the largest which has yet been employed in locomotives of this type with staybolt type fireboxes. The principal dimensions of these locomotives are compared in the accompanying table with the two largest locomotives of this type.

The Kansas City Southern Locomotive Compared with the Two Largest Locomotives of the 2-10-4 Type

Road	C. & O.	A. T. & S. F.	K. C. S.
Road No.	3002	5000	900
Builder	Lima	Baldwin	Lima
Date built	1930	1931	1937
Tractive force, eng., lb.	91,584	93,000	93,300
Tractive force, booster, lb.	15,000	.....	.....
Weight engine, lb.	566,000	502,600	514,000
Weight on drivers, lb.	373,000	348,200	353,000
Cylinders, diam. and stroke, in.	29x34	30x34	27x34
Driving wheels, diam., in.	69	69	70
Steam pressure, lb.	260	300	310
Grate area, sq. ft.	121.7	121.5	107
Heating surface firebox, sq. ft.	645	592	500
Heating surface total evap., sq. ft.	6,635	6,143	5,154
Superheat. surface, sq. ft.	3,030	2,550	2,075
Comb. evap. and superheat., sq. ft.	9,665	8,693	7,229

The Boiler

The boilers on these locomotives are 92 in. outside diameter at the first course; the second course is tapered, and the third course, which is straight, has an outside diameter of 102 in. The thickness of the nickel-steel shell in the three courses is 1 in., 1-3/32 in. and 1⅛ in., respectively.

The firebox is provided with a combustion chamber which extends forward into the boiler 75 in. The distance from the top of the crown sheet at the front and the inside of the wrapper sheet is 29-31/32 in., thus providing more than usual steam space over the firebox.

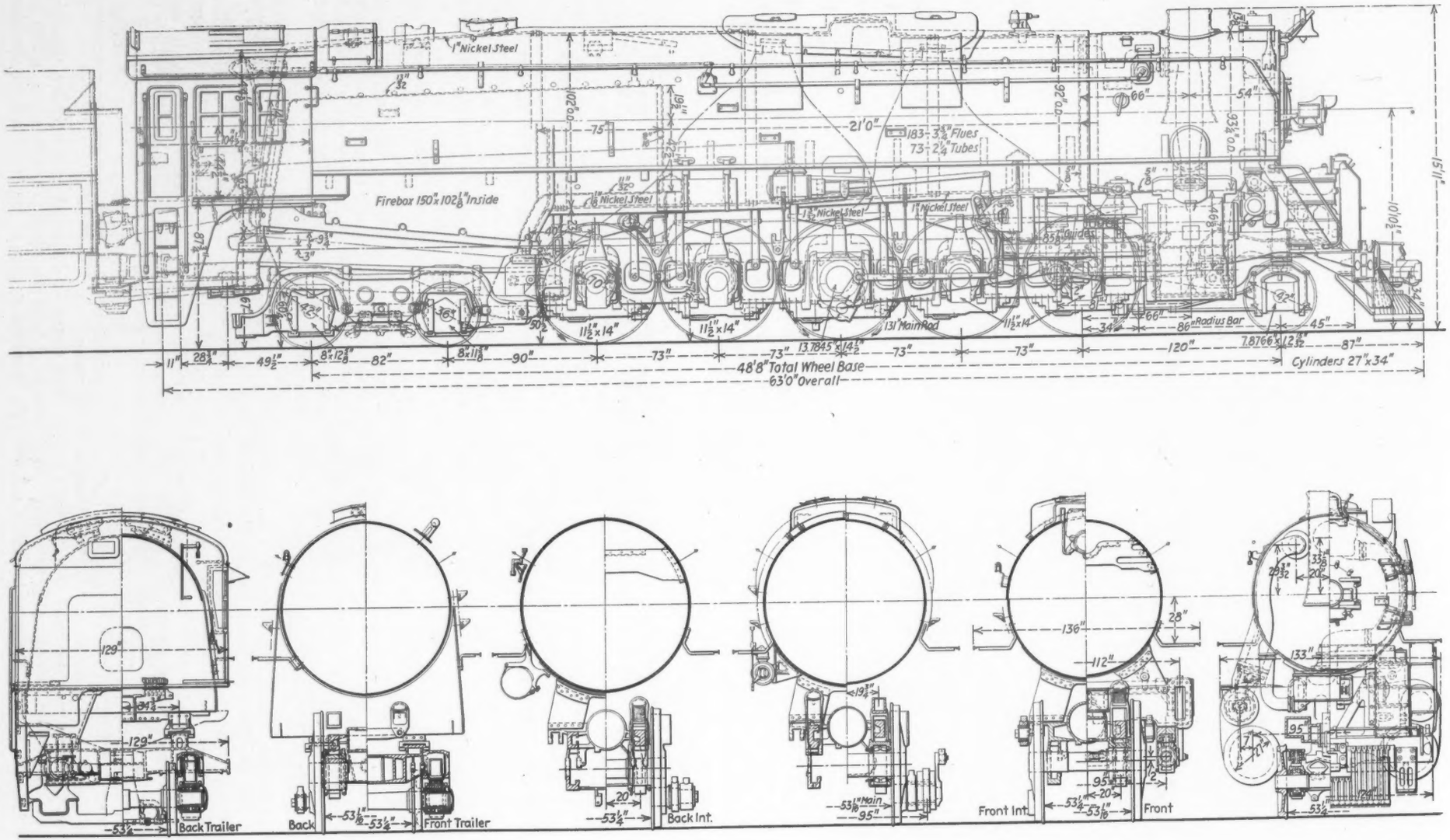
The side sheets, crown sheet, combustion chamber and inside throat sheet are welded. The inside door sheet and the tube sheet are riveted in place. The calking edge of the former, however, is welded up 36 in. from the mud ring and all inside and outside firebox sheets are welded at the calking edges around the mud ring. Calking edges of all seams adjacent to flexible staybolt sleeves are also welded. In the construction of the shell the longitudinal seam of the first course is seal welded 12 in. at the back and 15 in. at the front.

The combustion chamber is fitted with a complete installation of flexible staybolts as are also at the top, ends and upper corners of the side sheets. The coal-burning locomotives are equipped with Standard BK stokers and Firebar grates. They are fitted with ash pans of unusually large capacity.

The boilers include the Type E superheater, the units of which are installed in No. 10 BWG tubes of 3¾ in. outside diameter—one of the first, if not the first, installation of tubes of this size. The superheater header includes the American multiple type throttle valve with a maximum lift of 1¾ in. The drypipe is fitted with a Tangential steam dryer.

All of the locomotives are fitted with the Worthington Type 6 feedwater heater. The heater is mounted in the top of the smokebox and the exhaust pipe from the cylinder to the feedwater heater is attached directly to the cylinder inside the smokebox. The hot-water feed pump is located ahead of the cylinder saddle under the smokebox and is rigidly mounted on the bed casting. The hot-water line is designed to have a direct head of water from the heater to the pump. Where it emerges from the smokebox a single elbow casting connects it with the pump.

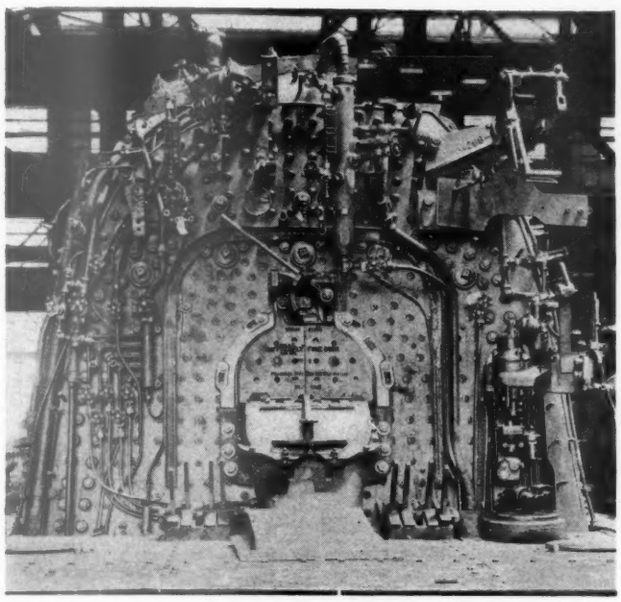
The water is delivered to the boiler through a top check. Under the check are baffle plates which break up the entering stream of water. Back of the check is a



Elevation and cross-sections of the Kansas City Southern 2-10-4 type locomotive

transverse swash plate and just in front of the back tube sheet is another. The boiler is equipped with the Model C Gunderson process apparatus for boiler-water treatment.

The smokebox on the oil-burning locomotives is based on the railroad's standard type of exhaust nozzle with



Back head of one of the coal-burning locomotives, showing the arrangement of piping under the jacket

Venturi gas nozzle. No netting or deflector plates are used.

The foundation of the locomotive is a General Steel Castings bed casting, of which the cylinders and back cylinder heads are an integral part. This casting also includes the main reservoir. The front bumper, however, is cast separately. There are four waist sheets, all of which have sliding fits on the boiler.

The cylinders are 27-in. by 34-in. and are fitted with three-step bushings of Hunt-Spiller gun iron. The same material is used in the valve bushings. The steel pistons and the valves are both fitted with Hunt-Spiller gun-iron bull rings and Duplex sectional packing rings.

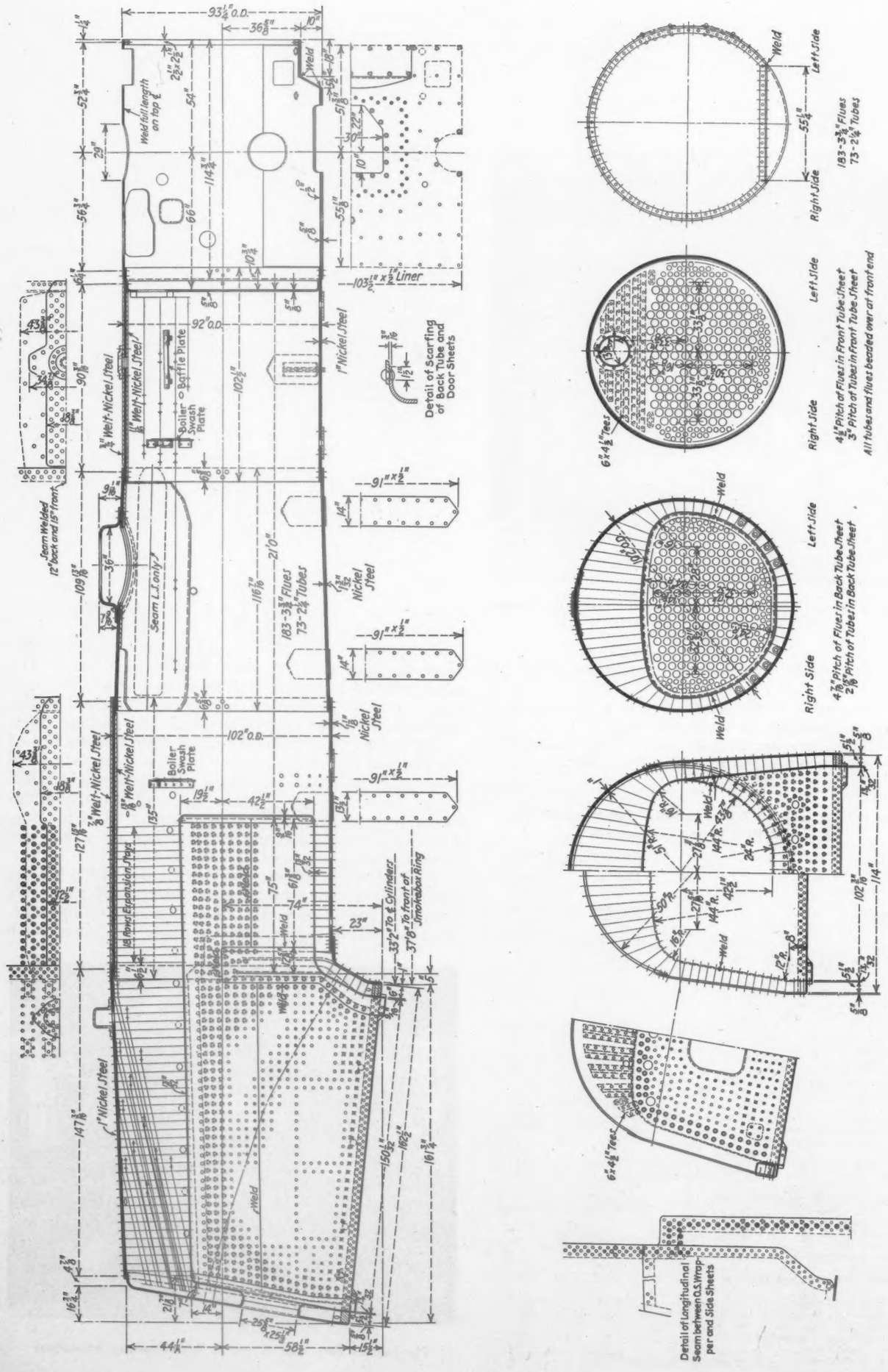
The driving wheels are 70 in. in diameter and are of the Boxpok type. The main journal bearings are fitted with SKF roller-bearing boxes, with journals 13.7845 in. in diameter by 14½ in. long. All other journals have crown bearings 11½ in. in diameter by 14 in. long. The first, second and fifth pairs of driving wheels are fitted with lateral-motion driving boxes.

The two-wheel engine truck is of the inside-bearing type and the four-wheel trailer truck is of the Delta type, both furnished by the General Steel Castings Corporation. The engine-truck journals are fitted with

General Dimensions, Weights and Proportions of the K.C.S. 2-10-4 Type Locomotives

	Coal-burn. K. C. S.	Oil-burn. K. C. S.
Railroad		
Builder	Lima	Lima
Type of locomotive	2-10-4	2-10-4
Road class	J	J
Road numbers	905-909	900-904
Date built	1937	1937
Service	Freight	Freight
Dimensions:		
Height to top of stack, ft. and in.	16-0	16-0
Height to center of boiler, ft. and in.	10-10½	10-10½
Width overall, ft. and in.	11-4	11-4
Length overall, ft. and in.	111-4⅛	111-4⅛
Cylinder centers, in.	95	95
Weights in working order, lb.:		
On drivers	353,300	350,000
On front truck	51,500	50,600
On trailing truck	109,200	108,400
Total engine	514,000	509,000
Tender	359,690	348,000
Wheel bases, ft. and in.:		
Driving	24-4	24-4
Rigid	6-1	6-1
Engine, total	48-8	48-8
Engine and tender, total	98-5	98-5
Wheels, diameter outside tires, in.		
Driving	70	70
Front truck	42	42
Trailing truck	42	42
Engine:		
Cylinders, number, diameter, stroke, in.	2-27 x 34	2-27 x 34
Valve gear, type	Walschaert	Walschaert
Valves, piston type, size, in.	14	14
Maximum travel, in.	7½	7½
Steam lap, in.	1 1/16	1 1/16
Exhaust clearance, in.	⅛	⅛
Lead, in.	¼	¼
Cut-off in full gear, per cent	85	85
Boiler:		
Type	Conical	Conical
Steam pressure, lb. per sq. in.	310	310
Diameter, first ring, inside, in.	90	90
Diameter, largest, outside, in.	102	102
Firebox, length, in.	150	150
Firebox, width, in.	102⅛	102⅛
Height mud ring to crown sheet, back, in.	72⅛	72⅛
Combustion chamber length, in.	75	75
Arch tubes, number and diam., in.	5-3½	5-3½
Tubes, number and diam., in.	73-2¼	73-2¼
Flues, number and diam., in.	183-3¾	183-3¾
Length over tube sheets, ft. and in.	21-0	21-0
Fuel	Soft coal	Oil
Stoker	Standard BK	....
Grate type	Firebar	....
Grate area, sq. ft.	107	107
Heating surfaces, sq. ft.:		
Firebox and comb. chamber	446	446
Arch tubes	54	54
Firebox, total	500	500
Tubes and flues	4,654	4,654
Evaporative, total	5,154	5,154
Superheating	2,075	2,075
Comb. evap. and superheat.	7,229	7,229
Feedwater heater, type	Worthington	Worthington
Tender:		
Type	Rectangular	Rectangular
Water capacity, U. S. gal.	20,700	21,000
Fuel capacity	25 tons	4,500 gal.
Trucks	6-wheel	6-wheel
Journals, diam. in.	6½	6½
General data, estimated:		
Rated tractive force, engine, 85 per cent, lb.	93,300	93,300
Weight proportions:		
Weight on drivers ÷ weight, engine, per cent	68.8	68.8
Weight on drivers ÷ tractive force	3.79	3.75
Weight of engine ÷ comb. heat. surface	71.2	70.5
Boiler proportions:		
Firebox heat. surface, per cent comb. heat. surface	6.9	6.9
Tube-flue heat. surface, per cent comb. heat. surface	64.5	64.5
Superheat. surface, per cent comb. heat. surface	28.6	28.6
Firebox heat. surface ÷ grate area	4.6	4.6
Tube-flue heat. surface ÷ grate area	43.5	43.5
Superheat. surface ÷ grate area	19.4	19.4
Comb. heat. surface ÷ grate area	67.5	67.5
Tractive force ÷ grate area	871	871
Tractive force ÷ comb. heat. surface	12.9	12.9
Tractive force x diam. drivers ÷ comb. heat. surface	903.4	903.4

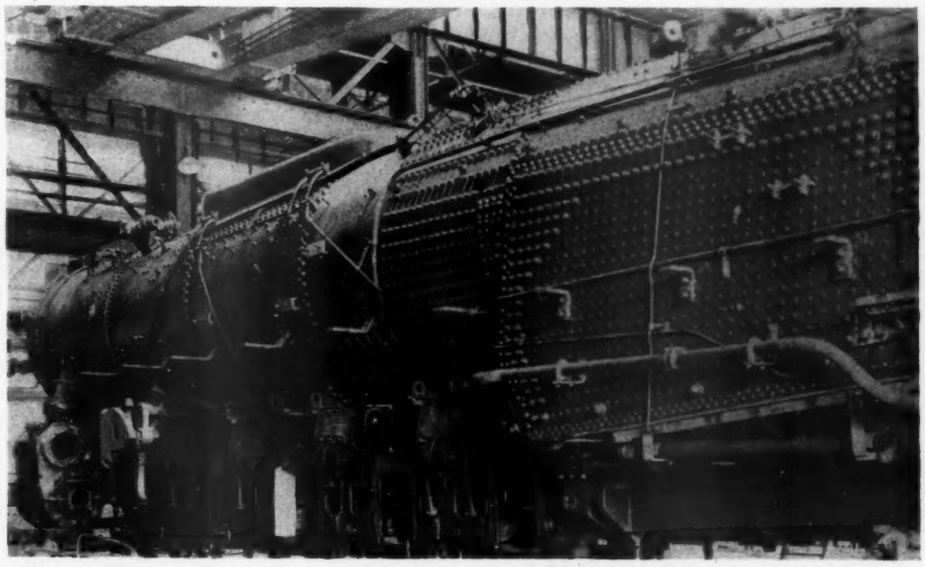
The finished back head of one of the oil-burning locomotives



Elevation and cross-sections of the boiler of the K. C. S. 2-10-4 type freight locomotive

SKF roller-bearing journal boxes. While the trailer-truck journals now have plain bearings, the trucks are designed with a view to the future application of roller-bearing boxes.

The guides and crossheads are of the multiple-bearing type. The locomotives are fitted with the Tandem type of main rod driving on the third and fourth pairs of wheels. The cylinder centers have a spread of 95 in.



A locomotive in the erecting shop before the application of lagging to the boiler

Equalization is broken between the third and fourth pairs of drivers. The first three pairs are cross-equalized with the two-wheel engine truck and the fourth and fifth pairs separately equalized on each side with the trailing truck. The spring hangers are of the stirrup type.

The locomotives are fitted with the Walschaert valve motion with a link of skeleton type construction. The maximum travel of the valve is 7¼ in. Franklin type B reverse gears are used.

Force-feed lubrication is provided for all driving-box hub faces, shoes and wedges, in addition to the usual feeds for cylinders, valves and guides. Detroit force-feed lubricators are fitted. Individual mechanical lubricators are provided for each air compressor.

The brakes are Westinghouse Schedule 8-ET and include two 8½-in. cross-compound air compressors which are mounted in front of the smokebox on the engine bed. The driver brakes on this locomotive are operated by five 12-in. by 10-in. cylinders. Two driver-brake cylinders, placed side by side on the guide yoke, operate the brakes on the first and second pairs of drivers and there is a separate brake cylinder for each of the third, fourth and fifth pairs of driving wheels.

Although no special cowling has been employed on these locomotives, they present an exceptionally neat appearance. Not only does this apply to the exterior of the locomotives, but also to the back heads within the cab as well. Here the arrangement of the piping under the jacket and the employment of a pedestal type brake valve conceals the usual confusion of piping in the locomotive cab. There are two sand boxes, one in front of and the other at the rear of the steam dome. They are combined with the steam-dome casing in a single structure. The locomotives are fitted with vestibule cabs.

The tenders have been built as large as possible within the limits of maximum axle loads for six-wheel trucks. The coal-burning tenders have a capacity of 20,700 gallons of water and 25 tons of coal and weigh, loaded, 348,000 lb. They are built up of Cor-Ten steel on the General Steel Castings water-bottom type underframe. The tenders are carried on Buckeye trucks which are fitted with SKF roller-bearing journal boxes. The trucks are fitted with Simplex unit-cylinder clasp brakes.

The general dimensions, weights and proportions of these locomotives are given in the table.

Partial List of Materials and Equipment on the Kansas City Southern 2-10-4 Type Locomotives

Boiler shell and wrapper sheet, nickel steel	Lukens Steel Co., Coatesville, Pa.
Lagging, 85 per cent sectional magnesia	Johns-Manville Sales Corp., New York
Flexible staybolts (Lewis special staybolt iron)	Joseph T. Ryerson & Son, Inc., Chicago
Tubes and flues	National Tube Co., Pittsburgh, Pa.
Arch-tube and washout plugs	Huron Mfg. Co., Detroit, Mich.
Firebox	Lukens Steel Co., Coatesville, Pa.
Fire door, Butterfly No. 8	Franklin Railway Supply Co., Inc., New York
Fire brick	Economy Arch Co., St. Louis, Mo.
Grate bars (on coal-burning locomotives)	Waugh Equipment Co., New York
Stoker, Standard type BK (on coal-burning locomotives)	Standard Stoker Co., Inc., New York
Smokebox blower fittings	Barco Manufacturing Co., Chicago
Front-end hinges	Okadee Company, Chicago
Superheater and Tangential dryer, Type E	Superheater Company, The, New York
Feedwater heater, Type 6-SA-100000	Worthington Pump and Machinery Corporation, Harrison, N. J.
Feedwater hose	Gustin-Bacon Mfg. Co., Kansas City, Mo.
Low-water alarm, Type B-3	Nathan Manufacturing Co., New York
Pipe fittings	Crane Co., Chicago
Bed casting and bumper (not integral with bed castings)	General Steel Castings Corp., Edystone, Pa.
Engine truck	General Steel Castings Corp., Edystone, Pa.
Engine-truck roller bearings	SKF Industries, Philadelphia, Pa.
Driving-box bearings, Arctic bronze	National Bearing Metals Corp., St. Louis, Mo.
Main driving-box roller bearings	SKF Industries, Philadelphia, Pa.
Trailer truck, Delta	General Steel Castings Corp., Edystone, Pa.
Coupler and pocket, A. A. R. Type E	Buckeye Steel Castings Co., Columbus, Ohio
Shoes and wedges, phosphor bronze	National Bearing Metals Corp., St. Louis, Mo.
Wheels, engine truck and front trailing truck, rolled steel	Edgewater Steel Co., Pittsburgh, Pa.
Wheels, trailing truck, rear, Boxpok centers	General Steel Castings Corp., Edystone, Pa.
Driving wheels, Boxpok type	General Steel Castings Corp., Edystone, Pa.
Tires	American Locomotive Co., Railway Steel Spring Div., New York
Springs	American Locomotive Co., Railway Steel Spring Div., New York

(Continued on page 570)

Inspection and Safety*

By John M. Hall†

Inspections which disclose condition of equipment of paramount importance in assuring safety and reliability of operation in service

We are all concerned in some manner with dependable locomotive performance, likewise we are all anxious to have safe performance. If the locomotives on any railroad in competitive territory (and where is the railroad that does not have competition?) fall short of the best possible performance, your rivals in the transportation field, be it railroads, trucks, busses, or airplanes, will surely get some of the business that your road would otherwise have retained. We are all too familiar with the results of loss of business; it affects everybody, all the way down the line.

The improvements made in recent years in average train speed, increased tonnage, and reduced fuel consumption per unit of work performed were contributed to by many factors, but the most essential element in these accomplishments is the locomotive. The value of a railroad as an efficient medium of transportation is dependent upon the fitness of its locomotives, and it is no doubt evident to all that these operating achievements could not have been accomplished if the locomotives had not been in generally good condition, however, speaking of the railroads as a whole, there is still room for much improvement in this direction. Even though the roadway, bridges, track, signals, terminals, stations, and all other facilities may be first class in all respects, and those in charge of operation highly skilled in that science, the maximum results cannot be attained if all locomotives in use are not maintained in a high state of serviceability. Safety, speed, long locomotive runs, maintenance of schedule, increase in train load, fuel conservation, are impossible of attainment if locomotives are not efficient and dependable. Rightly directed efforts to improve the present condition will be rewarded by new records of achievement in fast, safe, dependable, and economical transportation.

Problems of Mechanical Forces

Too often in attempts to get trains moving pressure is brought to bear on the mechanical forces to furnish locomotives that are not in condition to complete the trip safely and expeditiously. This situation was largely responsible for the enactment of the Federal locomotive inspection law. The framers of the law recognized that poorly maintained locomotives are a menace to safety.

If a locomotive is despatched in inefficient or unsafe condition we are taking an unjustifiable chance on an engine failure which may possibly result in an accident involving personal injury or death. When a locomotive is despatched with same weakness existing the least that may be expected is an engine failure and the effects of an engine failure are often far reaching. Failure to maintain the schedule of the train directly concerned is frequently the least important feature. Often the orderly movement of trains over a whole division is disrupted, the disruption sometimes extending to other divisions and connections. The total cost is indeterminate because it is not possible to evaluate the effect on the passenger or shipper who is inconvenienced and whose disappointment may react on the railroad.

The probable additional result of an engine failure is serious personal injury or death for one or more persons. It is the prevention of these occurrences that the locomotive inspection law endeavors to accomplish. Our inspectors still find defects on locomotives that have existed for some considerable time without any apparent notice having been taken of them by the railroad companys' employees and officers, and also defects that have been repeatedly reported by the companys' employees, and thereby brought to the attention of the proper officers, but which have not been repaired, or which show indications of ineffective attempts to make repairs.

Responsibility

The locomotive inspection law and rules are specific in placing responsibility upon the railroad company for safe construction, the making of inspections, and maintaining locomotives in proper condition and safe to operate without unnecessary peril to life or limb, yet it is not uncommon to be asked by a responsible representative of a railroad company for acquiescence in the use on locomotives on his railroad of practices long recognized as unsafe, and which if applied to a car received in interchange, would not be accepted for movement over his line.

Another procedure that is sometimes followed is to apply parts or appurtenances, or make repairs, in a manner that cannot be justified from the standpoint of safety, and then, after placing in service, attempting to obtain rulings or interpretations that will permit use ostensibly within the legal requirements. Such attempts are usually accompanied by the pretext that it would be expensive to remove the locomotives from service and make proper changes, that the parts or appurtenances, or method of repairs, are less costly than recognized conventional standards, and by the suggestion, if not argument, that the changes are "modern," when, in fact, similar, if not identical arrangements have long since proved themselves to be unsafe. We are not believers in the axiom that "there is nothing new under the sun" but it would seem that there is considerable truth in this old saying as such practices are indulged in not only by those who may have little knowledge of the ruggedness and dependability necessary to insure safety in railroad equipment and who probably are not familiar with what has heretofore been tried and discarded, but also by others who should be in a position to realize that attempts to reduce the degree of safely now afforded, no matter how much they may personally gain if successful, are not in line with "modern" progress.

The desire to create something new or different, or to deviate from current recognized practices that have been developed in the laboratory of actual experience is laudable only if the outcome promises to result in eventual savings, or is more useful, or both, and without any sacrifice of safety in either case.

* Abstract of an address before the New England Railroad Club, Boston, Mass., November 9, 1937.

† Chief inspector, Bureau of Locomotive Inspection, Interstate Commerce Commission.

It might be emphasized that the purpose of the Locomotive Inspection Act as expressed in the title is to "promote the safety of employees and travelers upon railroads." Therefore, it is the intent of the law that the standards of safety be continually improved, rather than that concessions may be made to permit operation of equipment or use of devices or processes of doubtful safety merely because it might be thought by some that we should go "modern" irrespective of the effect it may have on the casualty list.

Every generation has its own interpretation of "modern." While modern human beings are considerably more open-minded and tolerant than their predecessors I am not sold on the idea that the current interpretation gives us license to cut corners on matters of safety without giving due weight to the fact that taking a chance is keeping open house for death. The attitude of the Bureau of Locomotive Inspection is not ultra conservative; however, our responsibilities in seeing that the purpose of the law and rules is accomplished are too great to permit us to acquiesce in, or condone, the use of equipment that would reduce the degree of safety now afforded.

The duties imposed upon the carriers by the law are absolute and continuing. The fact that a Federal inspector has not taken exception to a condition, method of repair, or method of inspection, does not relieve the carrier from the responsibility placed upon it.

Changes in Equipment and Practices

There will be, and of course should be, changes in equipment and repair practices as the state of the art progresses. These changes have gone on for ages, sometimes slowly, at other times with great rapidity though frequently accompanied by costly errors due to overlooking the importance of fundamentals. Today is a time of rapid change in the railroad world, as well as in other lines of activity, but we will advance only to the extent that we keep our feet on the ground and select that which, in the light of past experience and current available knowledge, promises to be useful and safe. It is far more important that all parts of a locomotive function reliably than it is that they be constructed in accordance with the latest theory.

Inspections and Repairs

It is the purpose of the inspections required by the locomotive inspection law and rules to detect weaknesses that may have been unintentionally or thoughtlessly incorporated in construction or when making repairs, and to disclose deterioration that inevitably develops in service. It is the first duty of our inspectors to see that the carriers make the specified inspections in accordance with the rules and regulations and that the carriers repair the defects disclosed before the locomotives are again put into service. It is therefore necessary that vigilance be exercised to discover all defects and all conditions that indicate a defect is in the process of development, and if this procedure is carried out conscientiously and thoroughly, and proper repairs made at the proper time, we will have practically eliminated engine failures which are a waste of money, and their accompanying personal injuries which are a waste of human resources. If engine failures or train delays must be had the proper place to have them is at the terminal where safe and economical repairs can be made.

The words "economical repairs" are not here used in the sense of cheapness—there is no actual exemption from admission charges to the realm of dependable performance and service; however, there is a rebate on these charges that is recovered as time goes on. Economical repairs are substantial and consequently cost more money at the time they are applied than the inferior work that always accompanies cheapness. The difference resolves itself into the fact that economical repairs are in the long run low cost repairs because they are lasting and pay a dividend in the shape of superior all around performance, while cheap and consequently inferior repairs result in consistently poor performance and are a continual source of expense and danger.

As an example I might cite an illustration of inferior repairs that caused the loss of one life and resulted in much greater cost than would have been incurred had a thorough job been done either after the defective condition was first reported or after it became manifest that the repair measures employed were not effective:

> "The left bottom crosshead shoe lost out on account of loosely fitted bolts breaking. A piece of the wreckage was thrown backward and struck the fireman causing injuries from which he died a few hours later. Reports of the condition of the bolts were made at the ends of each of seven trips prior to the accident and the repairs made consisted only of tightening the nuts on the bolts."

The loose condition of the bolts had been known for some time and this should have been construed as a danger sign by those responsible for the maintenance of the locomotive.

Protective Devices

Because of the skill developed by those whose duty it is to make the inspections most of the weaknesses and deteriorations of parts of locomotives can be found by thorough examinations but unfortunately there are occasional instances where impending failure seemingly defies detection. It is here that protective devices, or constructions that minimize damage and personal injuries, prove their value. Water glass shields that prevent the shattered glass from flying in the event of breakage of tubular water glasses represent one such device. Another is the mechanically operated fire door.

A comparatively recent accident caused by the failure of a front end steam pipe on a prominent railroad furnishes a typical example of what is accomplished in the saving of lives and reduction of injuries to a minimum by the presence of protective devices. This accident occurred while the locomotive was pulling a passenger train at a speed of about 45 m.p.h. A piece broke out of a front end steam pipe leaving a hole in the pipe approximately 4 inches wide and 21½ inches long through which steam escaped into the smoke box and thence back through the flues into the firebox. At the instant of failure of the steam pipe the fireman had just stepped on the fire door operating pedal and was looking into the firebox. He was forced backward against the coal gate, then attempted to get to the left gangway, and finally succeeded in getting over the top of the coal gate and into the coal pit. His injuries, though painful, were not of a permanent nature.

The engineman closed the throttle and applied the brake and sanders as quickly as possible, then opened the front cab window and put his head outside to escape the effects of the gas and heat. When the train stopped he found practically the entire interior of the cab to be on fire. The engineer was not injured to the extent of causing him to lose any time.

The volume of steam that escapes back through the flues and into the firebox in instances of this kind, causing a blast in the reverse direction to normal, acts like a giant blow torch discharging through the fire door if open, and pours into the cab a mixture of hot gas, burning coals, and steam. If this blast is not instantly shut

off, as occurred in this case by the removal of the fireman's foot from the operating pedal and the automatic closing of the fire door, there is little if any chance for those in the cab to escape fatal injury or instant death. The further liability is always present of the engineer being prevented from closing the throttle and applying the brake and the train continuing uncontrolled and colliding with another train or being wrecked from other causes.

I have spoken of the mechanically operated fire door as a protective device but it was originally conceived and applied as an economy device—to enable a more efficient job of firing to be done—to save coal. Thus this comparatively simple device serves a dual purpose—safety and economy. It is only one of a number of devices or constructions used on locomotives, either primarily applied for safety, or primarily applied for economy, that result in safer and more economical operation.

A water glass on the left side or back head of the boiler, in addition to the water glass attached to a water column on the right side, is another device that serves the double purpose of safety and economy. Its presence enables the fireman to readily see the water level at all times from his usual position which is a distinct aid in an efficient job of firing. A further, and more important purpose is the additional assurance provided that incorrect water level indications make themselves manifest by difference in the levels in the two glasses thus enabling prompt steps to be taken to protect the boiler against the effects of low water. A recent disastrous explosion, in which three persons were killed, might have been prevented by the presence of a second water glass on the left side of the boiler. This explosion occurred shortly after the train had left a water tank stop at which the tender cistern was filled and an informal report made to the despatcher that poor time had been made to that point due to the feedwater pump not properly supplying the boiler. After the explosion the top cock of the water glass that was mounted on the water column was found closed which indicated that the cock had been closed, probably at or before reaching the water tank, in an attempt to raise the water in the glass, and probably in the hurry to get the train moving and avoid delay the fact that the cock was closed was forgotten. If this boiler had been equipped with an independent water glass on the left side the condition of the right water glass would no doubt have been discovered in time to prevent the accident.

Safety Glass in Cabs

Another opportunity to increase the safety of operation of locomotives has been largely overlooked by the railroads. I refer to the use of safety glass in the front cab doors and windows and in cab storm windows. Practically all regulatory authorities having to do with motor vehicles require the use of safety glass, especially in the windshields, and the reasons that underlie this requirement apply equally to front cab doors and windows and to cab storm windows on locomotives. Safety glass is now used throughout in a small number of locomotives propelled by power other than steam and in some few other instances it is used in the front cab doors and windows and in cab storm windows, but ordinary glass is used throughout on the vast majority of locomotives, both steam and those propelled by other forms of power. The use of ordinary glass in the front windows and in storm windows constitutes an unnecessary hazard to enginemen and others who may be riding in the cab as is evidenced by an increasing number of injuries caused by the breaking and shattering of glass from these windows.

Firm Grip and Safe Foothold

Published statistics covering the year 1935 show that falls of persons in train service accidents resulted in the death of 27 percent of all employees killed and 30 percent of all employees injured in train service accidents. In addition 25 employees were killed and 1,762 were injured in falls of persons in non-train accidents, which was 18 percent of all employees killed or injured in non-train accidents.

Falls when in the performance of duties while working on locomotives also constitute a prolific source of injuries. In the last fiscal year there was reported to the Bureau a total of 87 accidents in which 4 employees were killed and 83 employees injured from this cause. None of these falls could be attributed to any features encountered in connection with the condition of locomotives, it being apparent in each instance that the falls were caused by inattention or sudden illness on the part of those killed and injured. These accidents do not come within the scope of the locomotive inspection law but are mentioned here in order to emphasize the necessity of a firm grip and safe foothold and alertness on the part of all concerned.

Reporting of Accidents

The rules provide that in the case of an accident resulting from failure, from any cause, of a locomotive, its boiler, or tender, or any appurtenances thereof, resulting in serious injury or death to one or more persons, the carrier owning or operating such locomotive shall immediately transmit by wire to the chief inspector a report of such accident. A further provision is that when the locomotive is disabled to the extent that it can not be run by its own power, the part or parts affected shall be preserved intact, so far as possible without hindrance or interference to traffic, until after our inspection.

The channels set up by some of the carriers through which reports of accidents are supposed to be made to the chief inspector are so circuitous that reports are often unduly delayed, in some instances the parts affected are not preserved intact, and sometimes no reports are made. Without expressing any opinion as to the purpose, if any, of failing to make the reports in the manner provided it might be said that such procedure tends to defeat the purpose of the law as it prevents the conducting of as thorough investigations as could otherwise be made. Inasmuch as accidents coming within the scope of the locomotive inspection law originate on equipment for which the motive power department is accountable it would appear that responsibility for properly reporting these accidents should be placed upon that department.

Reduction of Accidents and Casualties

In the fiscal year ended June 30, 1937, the number of inspections of steam locomotives made by our inspectors was 100,033; the number of locomotives found defective was 12,402, or 12 percent of the number inspected; a total of 49,746 defects were found; and 934 locomotives were ordered out of service because of the presence of defects that rendered the locomotives immediately unsafe.

In 1937 increases occurred in the number of accidents, the number of persons killed, and the number of persons injured as compared with the year 1936; these increases were due to a greater volume of traffic handled by the railroads and to two particularly violent boiler explosions in one of which four persons were killed and in the other three persons were killed. Considering the circumstances, this is a very creditable showing, particularly if a comparison is made with the year 1923. The results for 1937 compared with 1923 show a decrease in acci-

dents of 80 per cent, a decrease of 65 per cent in the number of persons killed, and a decrease of 82 per cent in the number of persons injured.

The accidents and casualities that occurred in connection with failures of boilers and boiler appurtenances in the fiscal year ended June 30, 1937, compared with the year 1912, the first year the boiler inspection act became effective, are shown in the table. The original act applied to boilers and their appurtenances only and the table shows the relative improvement in safety of these parts.

Safety and economy are inseparable twins; if locomotives are maintained in the safest possible condition the maximum in efficient and economical operation will be attained. The interests of the Bureau of Locomotive Inspection and of the railroads are mutual in this respect because the ends sought by each are similar and can be attained only through exactly the same means—thorough inspections and timely and proper repairs.

Accidents and Casualties Caused by Failure of Some Part or Appurtenance of the Steam Locomotive Boiler

	Fiscal year ended June 30—	
	1937	1912
Number of accidents	63	856
Percent decrease	92.6	
Number of persons killed	19	91
Percent decrease	79.1	
Number of persons injured	73	1,005
Percent decrease	92.7	

Calculations Versus the Feel of the Thing in

Diesel Engine Development

CHARLES F. KETTERING, vice-president and general manager of the General Motors Corporation, has the faculty of discussing difficult and complicated engineering questions and scientific problems in a simple, understandable and most interesting way; indeed he is today regarded as one of the most popular, if not the most popular, speakers in the engineering and scientific world.

In discussing extemporaneously the possibilities of the Diesel engine in railway service at a luncheon given by Alfred P. Sloan, Jr., chairman of the General Motors Corporation, to a group of railway officers and industrial leaders in New York on October 28, he made the following observations:

Another question is asked, "What is the future of this type of power development?" I haven't the slightest idea. We have been making an enormous number of automobile engines for years. We have built, up to the present time, about 40 millions such engines and we are still improving them every year. In terms of horsepower we are just starting on the Diesel engine. Last year, for instance, if we take four million automobiles as the baseline and conservatively estimate them, below the advertising man's wishes, at 50 hp. each, we made 250 millions of horsepower. I think that we made about two millions of horsepower of Diesel engines. So we are making one per cent of the horsepower today in Diesels that we make in gasoline engines. That leaves the whole future ahead of us and as we improve these things and get them better, they are going to fit into their adjusted places as the demands require.

Microscopic Tolerances

So you can look ahead with a great deal of interest to the future development of this type of power. It is always going to cost a little more than the gasoline engine, because the injectors are expensive to make. So far as I know they are about the most accurately made pieces of apparatus known. The limits on the pump for the very high-pressures at which they must operate are very small indeed. As we say in the shop, "Our limits are a quarter of a tenth of a thousandth of an inch." Let me give you that in terms which are a little bit different. You have all seen a log on a sawmill; if you took a three-foot log and sawed it up into inch boards, you will get 36 one-inch boards, less the sawdust. Now imagine you took a human hair and sawed it up into 120 parts, each part would be a quarter of a tenth of a thousandth of an inch.

We have to make our injector plungers fit that close because if we didn't, the oil would leak by the plungers when the pressure was applied and it would not get into the cylinders. No manufacturing fellow likes to make fits that close. But we just say, "that's right, make it the way you think it ought to be, and then it won't work." So you have to accept that. The interesting thing about it is, that after they are made to that high degree of accuracy they apparently don't wear very much. This is one of the puzzles we don't understand.

A Lot We Don't Know

Two of the troubles that bothered injectors ended in an entirely different manner from predictions. Plungers do not wear and the fine holes through which the oil is forced do not erode or wear out. All of which is another way of saying that there is a lot we don't know.

We are very likely to sit down at a calculating table, make some figures, and abide by them before the experiment—but we still have to experiment.

I am going to tell you a very interesting story about calculations. Recently they were taking some very beautiful motion pictures of a cat—a fellow held the cat upside down, and let him loose. He turned over and landed on his feet. We have known for a long time that cats do this. Now, a man in Cambridge University in England studied each motion of the cat and wrote the differential equations for it. When, to his very great surprise, he found that they checked perfectly, he said that that was the reason why the cat landed on its feet. But if the cat had stopped to figure out those equations as he turned over, he would have landed on his head.

The Feel of the Thing

The cat has the feel of the thing and that is the reason he can turn over. For many, many years we have been trying to tell all scientific people that there is something in experience which gives you the feel of the problem. We are just getting the feel of this new type of power. The first time maybe we didn't land on our feet, but we got part way over. We do have the greatest confidence in the world that the Diesel can be developed into a most important industry—one which will be of great service to the railroads, one which will put more men to work, and one which will expand our ideas of the uses of power beyond anything of which we now know.

Spray-Type

Air-Conditioning System

The Sturtevant Company develops unit in which cooling by evaporation is substituted for refrigeration at the lower temperatures within the cooling range —An ultra-violet sterilizer provides for uniformly healthful atmosphere within the car throughout the year

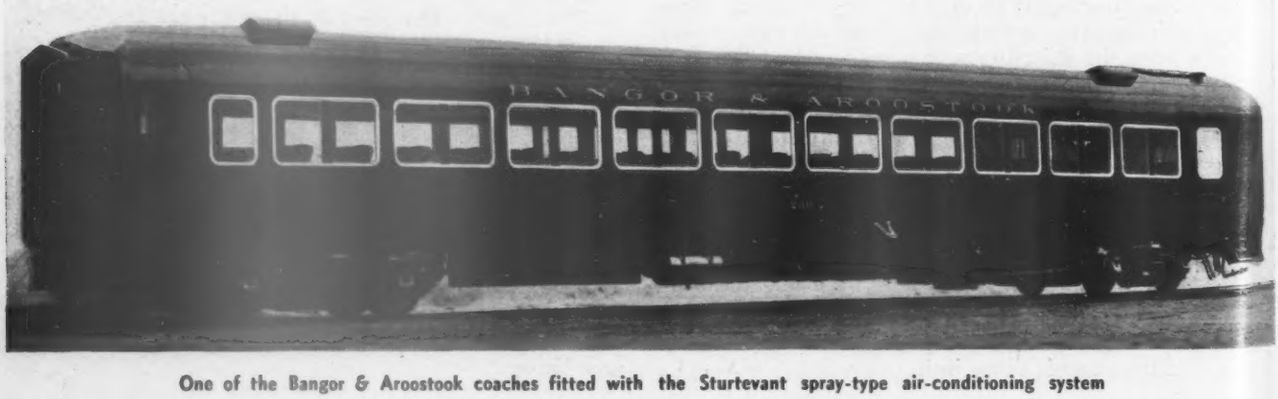
An application of the Sturtevant spray-type air-conditioning system in which has been incorporated an ultra-violet-ray sterilizer was made on the two new passenger coaches and three combination buffet coaches built by the Pullman-Standard Car Manufacturing Company for the Bangor & Aroostook during the past summer. The spray-type air-conditioning system on these cars is ice-activated but operates with evaporative cooling only when the outside wet-bulb temperature falls below a predetermined point. The ultra-violet-ray sterilizer operates during cold weather when the water spray is not in use. Combined with the sprays, which, themselves, have a sterilizing effect on the air, the ultra violet ray thus provides a year-round effect, so far as air-borne infection is concerned, equivalent to the operation of the air-conditioning system with a circulation of 100 per cent fresh outside air.

The Sturtevant air-conditioning units are overhead mounted and the ice bunkers, sumps and water-circulating pumps are mounted beneath the car body. The overhead equipment is assembled in two units. The fan and motor assembly is mounted over the vestibule, with the fresh-air grille in the vestibule ceiling. The washer unit, through which the air passes from the fans, is mounted above the ceiling near the end of the car. Each unit is completely self-contained. The washer unit is supported in a light frame of structural steel which is suspended from the car roof, thus relieving the unit itself of any distortion which might arise from direct attachment of the casing to the car structure. The unit is installed through a removable hatch in the car roof. The recirculating-air grille, which is located in the ceiling near the end of the coach, is connected by duct to the suction box of the blower unit. A central air-distributing duct down the length of the car distributes uniformly so that a gentle diffusion takes place, as it passes from the duct into the passenger compartment.

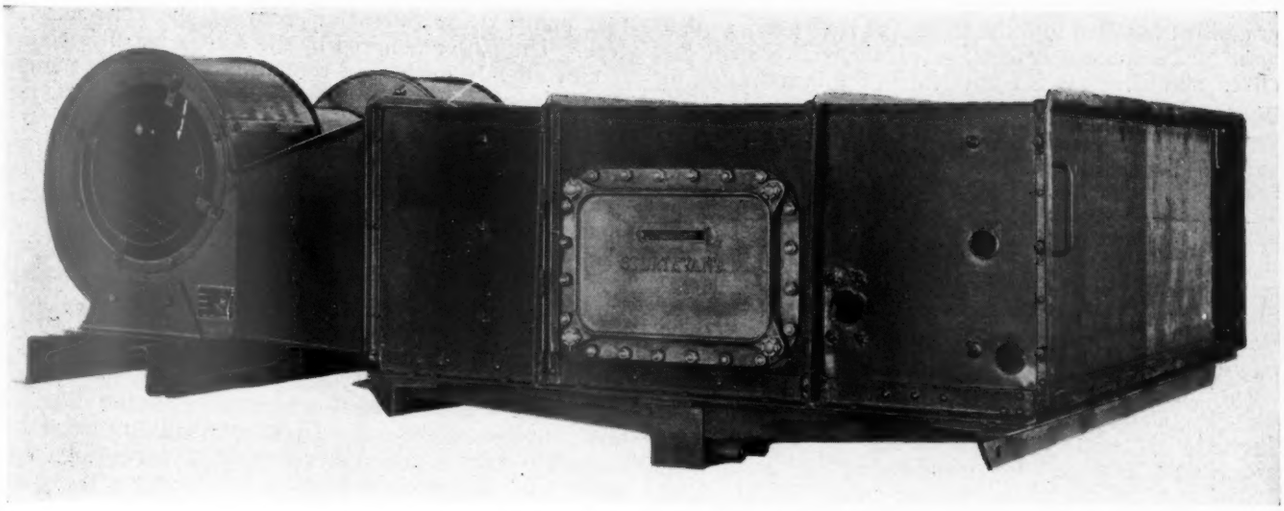
The fan and motor assembly consists of two single-width Rexvane centrifugal fan wheels, one mounted on the shaft extending from each end of the motor. The fan casings are split in order to facilitate the removal of the complete motor and fan assembly for repairs. The motor-fan unit is assembled in a suction box, with all balancing and adjusting of parts completed in the shop, and is installed in the car as a unit with wiring connections made in a single conduit box within the suction box. The motor is ¾ hp. in capacity, compound wound, and may be provided for 32, 64, or 110 volts d.c. In each case the motor is designed to permit operation with unregulated higher voltages at increased speeds. The normal operating speed of the motor is 1,200 to 1,500 r.p.m., delivering from 1,500 to 2,400 cu. ft. of air per min.

The washer casing is made of No. 16 gage galvanized steel and No. 30 oz. copper. The galvanized steel is used for the upper portion of the casing and the copper for the drain pan at the bottom. The joint between the two parts of the casing is sealed watertight with a special compound and no edges of the steel are exposed to the interior. The casing is buttressed with bands of light angle section and the bottom rests on a welded steel framework. Suitable marine access doors are provided to permit access to the interior of the casing for the removal or application of the spray nozzles. The doors fit against frames, producing watertight joints sealed with tubular rubber gaskets, and are held in place by four castle nuts each.

The copper drain pan has been designed of such proportions that no accumulation of spray water will occur in the overhead unit. A special hyperbolic streamline elbow carries the water from the spray nozzles immediately into a single return pipe leading from the bottom of the drain pan to the ice-bin sump beneath the car. Cars with insufficient headroom for a single return pipe from the drain pan may be equipped with two return



One of the Bangor & Aroostook coaches fitted with the Sturtevant spray-type air-conditioning system



The blower and spray cooling units of the Sturtevant air-conditioning system

pipes and special streamline fittings to accomplish the same result. In most cases, however, the single return pipe can be adopted and the amount of piping reduced to the same as is used with any conventional coil type air-conditioning units.

The principal feature of the air-conditioning unit is

Detail of patented bayonet latch-type nozzle

the use of spray nozzles which have replaced the usual type of cooling coils for the purpose of heat transfer. These nozzles are attached to suitable pipes branching from a single transverse water-distributing header by means of bayonet-lock joints and rubber gaskets. They are thus readily replaceable, although the smallest opening in each nozzle is $\frac{3}{16}$ in. in diameter and there is little likelihood of choking up with any material which may pass the strainer in the piping system beneath the car. They produce a deluge of highly atomized chilled water through which the circulating air passes. Air from the washer chamber is mellowed to the proper humidity, resulting in an atmosphere within the car which need not produce a sensation of shock to passengers entering it from humid, hot outside air. The omission of the main cooling coils removes a source of odor-producing accumulations, and the passage of the recirculated air through the spray tends to clear up odors originating in the car.

Built permanently into the casing near the end through which the air enters is a single fin-tube precooling coil fed by a ½-in. pipe. The use of the precooler is of advantage both in economy of ice consumption and in adequacy of evaporative cooling. At the opposite end of the casing is placed the steam-heat radiator which is a double fin-tube coil. Between the heating surface and the nozzles is a tri-hook moisture eliminator consisting of a bank of zigzag vanes, in passing through which the direction of the air is sharply changed three times. A similar eliminator is also installed at the entering end of the casing.

The controls are of the conventional type wherein the car temperature may be adjusted and automatically regulated to one of several thermostat settings to be made by the trainman. An additional selector control operated by an outdoor wet-bulb thermostat automatically changes the system from ice cooling to evaporative cooling. This control consists of a damper motor which operates to open and close a portion of the area through the outside-air intake grille and to cause the water circulation to bypass the ice bunkers. The wet-bulb thermostat is mounted in the fan suction box. When the wet-bulb temperature drops below a predetermined point (about 64 deg.)* the damper motor opens the outside-air damper and closes off the recirculation-air duct where it enters the fan suction box, thus producing 100 per cent fresh-air circulation. The circulating water for the sprays is caused to bypass the ice and cooling is entirely by evaporation. When the outside wet-bulb temperature rises above the setting of the wet-bulb thermostat the damper motor operates to close the fresh air-intake dampers and to open the duct from the return-air grille, thus restoring the circulation to the predetermined minimum proportion of fresh air—25 per cent in the case of the Bangor & Aroostook installation—and the water again circulates through the ice bunkers.

It is well known that in sneezing thousands of micro organisms may be discharged into the air and spread throughout any confined space. It has been found that the spray removes or destroys bacteria or other micro-

* A wet-bulb temperature of 64 deg. F. may occur in normal weather conditions with dry-bulb temperatures as high as 95 deg. F., according to official weather records and tests under actual railway car service conditions.

organisms expelled into the air by the passengers so that with the maximum percentage of air recirculation the effect within the car is equivalent to the introduction of cooled and nearly sterile outside air at the rate of 2,000 cu.ft. per min.

For wintertime use, when the sprays cannot be operated without window condensation and other difficulties, an ultra violet sterilizer has been developed. This consists of lamps of pure fused quartz, emitting high-intensity ultra-violet light, which are installed within the highly reflective aluminum recirculating box just above the return-air grille. The lamps are connected to a Sturtevant Railvane rotoformer for operation on 32 volt d.c. and require a total power input of 460 watts. The high-intensity ultra-violet light produces a sterilizing effect on the recirculated air practically equivalent to that produced by the spray operation during the summer, thus providing a uniformly low percentage of air contamination within the car throughout the year. The air purification design was developed with the aid of the consulting services of W. F. Wells and M. W. Wells of the University of Pennsylvania.

The cooling water is drawn from the overhead unit in most cases through a single return pipe from the drain pan leading to a sump beneath the car. A special design of pump with duplex impellers forces this cooling water through the conventional three-way bypass valve arrangement to the ice bins or directly back to the sprays in the overhead unit. Only one pump, therefore, is required per car, although some installations have been made using two pumps with single impellers of the conventional type. The power required by the double impeller pump is only slightly more than the power of a single pump. The three-way valve and its interconnecting piping to the ice bins and ice-bin sump is identical with the arrangement of such piping on cars equipped with conventional coil-type air-conditioning units, the setting of the valve being electrically controlled from the main automatic control switchboard panel.

Since chilled water is the essential means of conditioning the air passing through the spray unit, the design lends itself to the ice-storage system of cooling. The mechanical refrigeration system is readily adapted to the spray-conditioning unit, however, by replacing the ice bins with a water chiller beneath the car. The refrigerant from the mechanical system is expanded directly into the tubes of the water chiller through an automatic expansion valve. The chiller provides a storage of cold water and, in effect becomes a holdover reservoir at station stops.

An additional water-storage reservoir or sump of approximately 50 gal. capacity is recommended to be located in the water piping line between the water chiller and the drain pan of the overhead spray-cooling unit. The reservoir serves two purposes: First, it provides a supply of water for evaporative cooling in mild and dry weather; second, it provides a reservoir of relatively quiet-flowing water in which dust collected from the air by the sprays will precipitate, forming a sludge at the bottom which can be readily cleaned out at suitable periods.

Developments in Car Design*

By W. H. Mussey †

A discussion of the use of weight-saving and corrosion-resistant materials in car construction — Results of strain-gage tests of car structures

THE whole country is becoming weight conscious and the railroads and allied industries are alive to the irresistible urge. The more dead weight you save the less the demand on the power plant that hauls the train. Take a glance at the results to be obtained from the saving of deadweight in two types of service—passenger and freight.

Passenger and Freight Service

The public demand and the railroads are speeding up train schedules. In all cases the schedule is dependent upon the ability of the power plant to do the job and that means get into the terminal on time, taking into account not only the tightness of the schedule but delays, usual and unusual, that are bound to occur.

Railroads will not reduce the number of cars hauled below passenger-space requirements and the operation of two sections where one should answer is not worthy of consideration.

There are two vital factors which combine to make up train resistance and determine the amount of work the power plant must do—wind pressure and weight.

Streamlining is a very important item at extremely high speeds and on short trains, but as the length of train increases the advantage gained by streamlining decreases due to increase in skin friction. Streamlining contributes to reduction of train resistance, has eye appeal, and the public likes it. They sense that they are on a modern high-speed train.

When it comes to starting, accelerations after slowdowns and mounting grades, it is reduction in weight, not streamlining, that counts. From our own knowledge most high-speed passenger-train schedules stand or fall due to the ability of the power plant properly to handle starting, acceleration and grades and their importance seems to progress in the order named. Saving of dead weight permits train speeds of more miles per hour.

One might ask why not increase the size and capacity of the power plant. If it were practical by so doing to meet the power requirements imposed in making high schedules with heavy trains, it would be undesirable, from an economic standpoint, for reasons that must be obvious to all. As a proof of this, the manufacturer of the power plant, whether it be a steam locomotive or an internal-combustion engine, is the staunchest advocate, of the lightweight train for high-speed service.

The freight car offers a field only casually explored as to the savings that will result from the reduction in dead-weight tonnage.

A saving of five tons in dead weight of a box car

* A paper presented at a meeting of the New York Railroad Club, November 12, 1937.

† Engineer of research, Pullman-Standard Car Manufacturing Company.

means approximately 54,000 ton-miles per year. If all of the 730,000 box cars in service each represented a like reduction, the saving would be 39,420,000,000 ton-miles per year. You can't laugh that off!

New Material and Tools

New materials and new tools have been introduced which present the key to the attainment of the goal—the reduction in dead weight of railroad equipment.

Let us first consider the materials which are now available and their possible, or practical, application to the problem.

The materials are low-chrome high-tensile steel, stainless steel (18-8) in the cold rolled state and high-tensile aluminum alloy (17 ST) heat treated.

We give their physical characteristics in the order named and, as a comparative yardstick, I quote, first, normal low-carbon open hearth as per A.A.R. Specification (M-116-34).

LOW-CARBON OPEN-HEARTH STEEL

Plates for cold pressing	
Modulus of elasticity	28 to 30 million; average material 29 million
Yield point	24,000 to 29,000 lb. per sq. in.; actual minimum about 30,000 lb. per sq. in.
Tensile strength	48,000 to 58,000 lb. per sq. in.; actual minimum about 60,000 lb. per sq. in.
Elongation in 2 in.	Not covered by specification—minimum about 30 per cent

LOW-CHROME HIGH-TENSILE STEEL

U. S. Steel Specification for Cor-Ten	
Modulus of elasticity	28 to 30 million; average material 29 million
Yield point, minimum	50,000 lb. per sq. in.—average material 55,000 lb. per sq. in.
Tensile strength	60,000 to 75,000 lb. per sq. in.—average material 75,000 lb. per sq. in.
Elongation in 2 in.	23 to 28 per cent—average material indicates 28 per cent

STAINLESS STEEL (18 PER CENT CHROMIUM, 8 PER CENT NICKEL)

U. S. Steel Specification	
Modulus of elasticity	Quoted as 28 million
The above figure applies only to the material in the annealed state. When cold rolled for essential parts of car structures actual tests indicate 21 to 23 million.	
Yield point	60,000 to 125,000 lb. per sq. in.
Cold rolled specimens indicate a yield point considerably above 125,000 lb. per sq. in.	
Tensile strength	110,000 to 175,000 lb. per sq. in.
Elongation in 2 in.	10-45 per cent
The percentage of elongation decreases in proportion to the extent of the cold rolling. Tests made of material used in car structures indicate less than 20 per cent.	

HIGH-TENSILE HEAT-TREATED ALUMINUM (17 ST)

Specification of The Aluminum Company of America	
Modulus of elasticity	10,300,000
Yield point (typical)	35,000 lb. per sq. in.
Tensile strength (typical)	58,000 lb. per sq. in.
Elongation in 2 in.	20 per cent
Tests of average samples indicate..	26 per cent

We put the modulus of elasticity as the first item in each case as it is the dominating factor in the deflection formula. It has been the policy of the Pullman-Standard Car Manufacturing Company in designing all of its railway passenger equipment to keep within the requirements of the Railway Mail Service Specifications which in the past have always been the basis also of passenger-carrying cars purchased by the railways. We do not say that the new cars are stronger than the more conventional type of passenger-train equipment which has been operating on the rails during the past quarter century. We do, however, claim that the new cars built by this company are of equal strength to withstand buffing shocks with the older equipment and that they comply fully with the Railway Mail Service Specifications. If it were not for certain physical characteristics peculiar to aluminum and stainless steel of high-tensile grade, cars which are designed of these two materials could be somewhat lighter than it is possible to make them and still comply with the Railway Mail Service Specifications and the requirements of good car design.

The engineer has been accustomed to designing cars based on the stress calculations when using ordinary open-hearth steel. If this method is followed in the design of aluminum and high-tensile stainless-steel structures subject to buffing and other live loads resulting from operation in service, the car will present too much flexibility, due to the resiliency of these two materials which exhibit greater deflections in the high-tensile state than the low-chrome alloys for the same cross-sections when subjected to identical loads. For this reason it is necessary, in order to provide for the proper strength and rigidity of car structures to increase the cross-section of the load-carrying members made of aluminum or high-tensile stainless steel, subjected to compression stresses, sufficiently to keep the amount of deflection within satisfactory limits. In aluminum the cross-section can be satisfactorily increased and still have a resulting weight considerably under the weight of corresponding members built of any of the alloy steels, but the amount that must be added to the stainless-steel member increases the weight because a cubic foot of steel weighs the same whether it is of high-tensile stainless steel, or Cor-Ten.

The above outline briefly states the reason that the Pullman-Standard Car Manufacturing Company has confined its efforts to aluminum and low-chrome high-tensile alloy steel in the design and construction of its lightweight cars. As stated before, it is a question of economics. For this reason it is our belief that in the long run the majority of steel passenger cars will be built of moderately priced low-chrome alloys and that, when extremely light weight is desired, aluminum will be used.

It is a very interesting thing in considering some of the exaggerated claims of extreme weight savings over present lightweight equipment to realize that, for a Pullman sleeper car-body-framing members only, the weight has been decreased from 58,330 lb. for a conventional riveted car of low-carbon normal steel to 26,000 lb., and, for a coach, to 23,000 lb., both fully welded, and it must be evident to all that any considerable further saving cannot be obtained by reducing the car framing with the use of any type of steeel of which we have commercial knowledge. The additional saving must come by taking into account everything that goes inside or outside this car shell, as well as the trucks.

In the construction of freight cars the total cost of the car is relatively low as compared with passenger cars, and railroads, as a whole, have felt, whether they are right or wrong, that lightweight freight cars of ample strength to replace the present freight car must represent no material increase in cost. This naturally limits us, as we see it now, to low-carbon steel, with and without copper content and Cor-Ten steel, or equivalent, with its increased corrosion resistance. Two other materials—aluminum and high-tensile stainless steel—represent a cost per pound which, naturally, would add considerably to the cost of a freight car and, as we see it, would not be justified, except in special cases.

The spread in cost between normal low-carbon steel and low-chrome high-tensile steel amounts to something, of course, but, as we have clearly demonstrated, we can, commercially, in design and construction, utilize the higher yield point of this material to its fullest extent and make a larger reduction in weight. We are convinced that further considerable increase in yield point would be of small additional value and, of course, would entail an added cost considering any material commercially produced at present.

Corrosion Resistance

The cars we have designed and built have been constructed of Cor-Ten steel, or equivalent, and the results obtained have justified its use. Recent tests of the box car built by the Pullman-Standard Car Manufacturing Company which was on exhibit at Atlantic City in June have been viewed by officers of the A.A.R. and a good many railroad men covering a wide cross-section of the railroads of the country. They have demonstrated that the car is capable of standing at least as great and probably greater impact blows, both longitudinal (buffing) and vertical (live load), than the standard A.A.R. car. It must be said for the A.A.R. car, however, that it has fully met all operating requirements; the tests to which we subjected these cars are excessive and of a destructive nature.

There has been much discussion as to the corrosion resistance of various materials entering into car construction. This general term needs some explanation, or rather a statement of what corrosion really means.

There are, as we see it, two types of corrosion—one is straight atmospheric corrosion, which proper maintenance will fully take care of; the other type, which is more serious, is corrosion due to working of the sheets, localization of stresses, etc., which might be called accelerated corrosion. This is the problem. Undoubtedly, any material which has increased corrosion resistance, such as the low-chrome high-tensile steel, aluminum, except in the presence of alkalies, and stainless steel, with its high corrosion resistance properties, is a desirable thing, but to pay any considerable premium for this quality does not seem to be justified by the facts.

The Pullman Company has made various examinations of car structures built more than 25 years ago and others of less age and corrosion present as disclosed by the removal of inside finish sheets has been of a negligible character; in other words, we might say it is practically nil. That, of course, applies to passenger cars and is the result of proper design and maintenance.

Examination of many freight cars shows that what has been said of passenger cars also applies to freight cars. One very marked example of this is the five welded hopper cars which we built in 1931 for the Chicago Great Western with which you are all probably familiar. The coal that is hauled in these cars is of relatively high sulphur content and considerably more corrosive than the average coal, yet, from frequent examinations of these welded structures, which are of plain open hearth steel, we have found only a small low rate corrosion. There seems to be no doubt that the life of these cars will not be dependent upon corrosion of the essential parts of the structure. The same cannot, however, be said of riveted cars built at the same time, of the same material, and operating under the same conditions.

It is self-evident to all that have made even the most casual study of car design and car structures that the only possible way that we may reduce weight in car framing structures is to reduce the cross-sectional area or thickness of the sections, plate, bars and sheets that go to make up this structure and thereby take full advantage of the physical characteristics of the steels.

Of course, the customary riveting of car structures has proved very satisfactory in conventional car design because the heavier sections provide sufficient bearing area for the rivets. The net section left in the sheet, plates, etc., after the holes are punched in them is sufficient to develop proper strength in the car framing and it isn't necessary that the car represent, in effect, a one-piece structure, because the members are of sufficient size to stand various concentrations of stress and deflection. However, when we come to the thinner members it is necessary to obtain proper strength and weather tightness, and that means rivets, if used, which are placed very close together in the case of both superstructure and underframe. Then the net sections of a plate or sheet available to withstand severe service has been very markedly decreased. Furthermore, naturally the rivets would be of such size that they couldn't withstand the extreme concentrations produced by impact stresses.

Welded Construction

A study of welded construction convinced us that a welded structure properly designed and built would produce the strongest and lightest car.

It was further decided that the light sheets and, in fact, practically all of the superstructure would have to be spot-welded, both from a design and commercial standpoint. Arc or gas welding has the greater value in fabricating the underframe members and should be used, therefore, for the best results.

In 1935 we built a lightweight box car of Cor-Ten steel in which the underframe was partly arc welded and partly riveted. The superstructure was spot-welded. This car was built as an experimental lightweight car for the purpose of determining suitability of low-chrome high-tensile steel, or the soundness of the principles of design, the practicability of the type of welding equipment and the possibility of building such a car weighing 4½ tons less than, but at the same cost as, the A.A.R. standard car.

The box car was tested by the A.A.R. for static and live-load vertical loadings and under impact tests. After that it was put in service and has made in excess of 26,000 miles with no repairs.

Shortly after this we built an alloy-steel welded refrigerator car with outside welded-steel sheathing. The underframe was fully arc welded and the superstructure spot welded, using the same equipment for spot welding as had been used in connection with the box car.

The refrigerator car represents a saving of 10,000 to 13,000 lb. in weight over other cars of similar size and that car has made approximately 40,000 miles, with no repairs other than the usual run of maintenance items such as brake shoes, bearings, etc.

This demonstrated to us that a welded car could be built for severe service and it would give good results and be perfectly satisfactory.

Under the impact test of the lightweight box car (PLM No. 500) we had a chance to study a combination of riveting and welding on the underframe, the practicability of the spot-welding equipment available at the time this car was built and to study methods for reducing costs.

After a very careful analysis of the results obtained from impact testing and of the car in service, we thoroughly explored the field of spot-welding technique and equipment. In the first part of this year we convinced ourselves that steel freight cars could be produced at a low cost with absolutely reliable welds. The previous designs needed some modification to use the best that there was in spot welding. The same general fundamentals could be followed as practiced on the first car. The combination of riveting and arc welding on the underframe was not the equivalent of a fully welded construction. The center filler, back stop and the striking members were built up of rolled plates welded into the center sill conforming to the construction we have applied to many cars with most satisfactory results.

In April of this year we were authorized to build another welded box car of the new A.A.R. dimensions which are larger than the previous standard. The car was completed in May and was on exhibition at the A.A.R. convention in Atlantic City in June. It represented a saving of approximately five tons in deadweight over the A.A.R. box car of similar large dimensions.

In all of these cars we have used lightweight chilled-iron wheels which have represented a reduction in weight of 680 lb. per car and frequent inspection of these cars has demonstrated their serviceability.

This car has been subjected to most severe static and live load vertical loading and high-speed impact tests. The A.A.R. representatives and railroad men were present and witnessed these tests. None of the members of the car structure was distorted. Of the approximately 14,000 spot welds in the superstructure not one of them let go. In other words, we have proved that welded lightweight structures as represented by this car will assure the railroads of the ultimate in lightweight and strength, that the cars will not be on the repair track but in service, and the study of construction methods has convinced our company, and they have stated publicly, "This car can be produced without any premium in cost over the conventional riveted car."

As a further step in connection with the statement above, one of our freight-car-building plants is providing facilities and equipment has been ordered and will be installed for producing approximately 25 cars a day of this lightweight welded construction. The plans are to have this plant in operation within the first month of the coming year. The welding equipment will be largely automatic and the handling and fabrication will eliminate, as far as possible, manual handling.

Testing Car Structures

It might be of interest to give more information about the methods followed in making the tests. As we mentioned previously, after the lightweight welded box car was built it was thoroughly tested. In this series of tests we applied at approximately 125 positions on the car-body instruments which would record the stresses under both static and live load conditions, but, of course, the static condition means very little as compared with those of live load or impact.

These instruments we have known of for some few years, but we have not been able until this time to assure ourselves that we had the proper technique of the application, adjustment and determining the stresses which they recorded.

During the past summer we have been doing a lot of impact testing of car structures under extremely variable conditions and, through the aid of Professor Roy of the University of Illinois, who is at present associated with the Association of American Railroads, we reached such a point that we were positive that the results obtained were reliable that they could be used for testing car structures without any questionable reservations.

The instruments record the stresses, whether they be compression or tension, their magnitude, the number of vibrations per impact, whether the impact produces a stress beyond the yield point of the material, how much was due to bouncing of load and how much to straight impact and whether any permanent set or deformation occurred in the members upon which they were placed.

In order to make sure that our investigation was complete the 125 scratch gage instruments were applied at all critical stress points throughout the car body and other points to assure ourselves that there were no sudden changes in stresses and that the structure was acting as a whole.

The scratches or stress indications are recorded on a brass plate, chrome plated, and when removed from the tested member are placed under a microscope which has a definite magnification—about 75 diameters—and the readings of the various phenomena occurring during the impact are recorded and proper curves drawn to illustrate what has happened. A study of these readings brings out some very interesting facts. Whereas the car as tested under the observation of the A.A.R. has not shown any distortion after removal of load some of the recorded impact stresses have been in some cases beyond what we call the static yield point. For the lower speed impacts where the blow is not sharp they evidently follow very closely along the line of static stresses but as the higher impact speeds are reached there is a stress surge above the static yield point, in some few cases. Since the impact blows are applied almost instantaneously, the car structural members are subjected only momentarily to some localized stress which may exceed the static yield point, but not accompanied with a permanent set unless stresses are considerably above the yield point. This localized stress, unless excessive, even though it may have been somewhat above the static yield point, is immediately relieved after the impact, so as to produce practically no effect on the integrity of the structure and there has been no detrimental effect on the member under consideration. Undoubtedly this occurs at all times in all car structures. Or in other words, there is a vast difference between static stresses and impact stresses in their effect on the structure and the mere consideration of a static load to determine the stresses within a member or within a structure is of little value.

The recording of impact stresses, occurring as they do under certain localized conditions, permits the designer to make in most cases only a slight alteration and iron out the stresses even under this impact condition and thereby prevent any possibility of fatigue. This is the procedure we have followed on this lightweight box car.

There is another very interesting feature and that is the effect of impact as far as stresses are concerned upon the underframe and superstructure. Except at very low car impact speeds, which closely approach static conditions, the stresses are largely confined to the members of considerable cross-sectional area, presenting the most direct path for the transmission of the blow. The side sill and the floor stringers on an A.A.R. box car develop under usual operating conditions an infinitesimal stress as compared with the center sill which is in the direct path for impact forces transmitted through the coupler. This applies evidently to all types of construction even though the members are relatively held in place by the flooring. When the resultant line of buff or impact at the end of the car is raised due to the coupler horn hitting the striking casting it creates in the floor stringer and side sill considerably more stress but even then a fraction of the stress per sq. in. which occurs in the center sill. This brings out the fact that it is erroneous to give any great consideration under impact to the longitudinal members of the underframe other than the center sill as resistance to car impacts through the coupler.

Further indications point out that any buffing force that is applied along the underframe line has very little resistance from the superstructure. The fundamental of design is that under an impact on the underframe any use of metal or cross-sectional area in members other than the center sill to withstand buffing impacts is not an economic use of the material.

We have gone to the extreme to make these tests to

determine just what are the stresses due to the impact blows at the end of the underframe of both passenger and freight cars and to prove the truth or the fallacies of the many theories that have been advanced in connection with lightweight car design and construction, so that proper protection may be provided to the passengers, lading and structure under these severe conditions.

The impact recording gages indicate that the coupler shank in all cases starts to deform at speeds well below where car PLM No. 501, the car we have exhibited this year, shows any stresses near the yield point. At impacts of 10 m.p.h. the coupler shank had been stressed beyond the yield point of the material.

There seems to be a very marked effect on the stresses recorded in the framing members due to the characteristics of the draft gear. This is very clearly shown in various sets of impact readings which have been made with conventional draft gear and draft gear which produces better cushioning than the conventional gear. There are instances where the stress yield point was exceeded in certain members of the car structure with the conventional draft gear at impact speeds of 10 m.p.h. or a little less. With an improved cushioning device—which is really the office of the draft gear—we have readings which indicate that this point is reached at about 12½ m.p.h.

It has been the aim of our company constantly to study and analyze all the factors that enter into car design and construction. Then by means of the most exhaustive tests in the laboratory, on the test track and in service assure you as well as ourselves that equipment built as a result of these efforts will answer all operating requirements, have low maintenance costs, and have a satisfactory length of life.

Kansas City Southern Freight Locomotives

(Continued from page 559)

Rods, Tandem, articulated rod drive	Lima Locomotive Works, Lima, Ohio
Piston-rod packing, Crescent tandem type	T-Z Railway Equipment Co., Chicago
Piston-valve bushings; cylinder bushings; piston bull rings and Duplex sectional cylinder packing rings; valve bull rings and Duplex sectional valve-packing rings	Hunt-Spiller Mfg. Corp., S. Boston, Mass.
Power reverse gear, Type B	Franklin Railway Supply Co., Inc., New York
Brake equipment, Schedule 8-ET	Westinghouse Air Brake Co., Wilmerding, Pa.
Brake shoes	American Brake Shoe & Foundry Co., New York
Foundation brakes	American Brake Co., St. Louis, Mo.
Driving-box lubricator and spreader	Franklin Railway Supply Co., Inc., New York
Hydrostatic lubricator	Edna Brass Mfg. Co., Cincinnati, Ohio
Mechanical lubricator	Detroit Lubricator Co., Detroit, Mich.
Injector	Manning, Maxwell & Moore, Inc., Hancock Valve Division, Bridgeport, Conn.
Injector check	Edna Brass Mfg. Co., Cincinnati, Ohio
Steam and air gages	Ashton Valve Co., Boston, Mass.
Steam-pipe casing, Reid	Lima Locomotive Works, Inc., Lima, Ohio
Water column	Prime Manufacturing Co., The, Milwaukee, Wis.
Water gage, Type BX-5	Nathan Manufacturing Co., New York
Steam valve	Manning, Maxwell & Moore, Inc., Hancock Valve Division, Bridgeport, Conn.
Steam-heat equipment and valve	Gold Car Heating & Lighting Co., Brooklyn, N. Y.
Valves	Wm. Powell Co., Cincinnati, Ohio
Cocks	T-Z Railway Equipment Co., Chicago
Bell ringer, Gollmar	U. S. Metallic Packing Co., Philadelphia, Pa.
Throttle, Multiple type	American Throttle Co., New York
Speed recorder, indicating and recording type	Valve Pilot Corporation, New York
Sanders, Type BW	Morris B. Brewster Company, Chicago
Boiler-water treatment, Model C Gunderson process	Dearborn Chemical Company, Chicago
Clear-vision windows and windshield glass (safety)	Libby-Owens, Ford Glass Co., Toledo, Ohio
Side ventilators and engineer's seat	Gustin-Bacon Mfg. Co., Kansas City, Mo.
Headlight and generator	Pyle National Co., Chicago
Radial buffer, Type E-2	Franklin Railway Supply Co., Inc., New York
Flexible joints and pipe connections between engine and tender	Barco Manufacturing Co., Chicago
Unit safety bar between engine and tender	Franklin Railway Supply Co., Inc., New York
Tender:	
Frame, water-bottom type	General Steel Castings Corp., Eddystone, Pa.
Brake shoes, Diamond S	American Brake Shoe & Foundry Co., New York
Draft gear, friction type	W. H. Miner, Inc., Chicago
Truck, six-wheel	Buckeye Steel Castings Co., Columbus, Ohio
Truck springs	American Locomotive Co., Railway Steel Spring Div., New York
Friction snubber spring	Cardwell Westinghouse Co., Chicago
Bearings, truck, roller type	SKF Industries, Philadelphia, Pa.
Wheels, rolled steel, multiple wear	Edgewater Steel Co., Pittsburgh, Pa.
Tank valves	T-Z Railway Equipment Co., Chicago
Tank, top, sides and end plate, Cor-Ten	Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
Brakes, Simplex unit cylinder clasp	American Steel Foundries, Chicago
Coupler and yoke	Buckeye Steel Castings Co., Columbus, Ohio

Exhaust Steam Injector A Correction

The exhaust-steam injector of The Superheater Company, referred to in the Railway Fuel and Traveling Engineers' Association report on Improved and New Locomotive Economy Devices, will handle feedwater as hot as 105 deg., not 150 deg. as stated on page 480 of the October *Railway Mechanical Engineer*.

Fire drill on the Illinois Central—A fleet of 350 Illinois Central locomotives has been equipped with fire-fighting apparatus

EDITORIALS

Railway Mechanical Engineer Index for 1937

Entries for the material published in the Daily issues of the Railway Age, the first published at the Atlantic City conventions of the Mechanical and Purchases and Stores Divisions of the Association of American Railroads in June after a lapse of seven years, will be included in the 1937 index to the *Railway Mechanical Engineer* now being prepared. Being a subscriber to the *Railway Mechanical Engineer* does not insure your receiving the index. Our mailing list includes only those to whom the 1936 index was sent. New or old subscribers who did not receive a copy for that year are asked, therefore, to send in their requests as promptly as possible if they desire the 1937 and future indices.

Advance in Car Design

Early in October, 1937, a series of impact tests on the Pullman-Standard Car Manufacturing Company's lightweight, all-welded box car, PLM No. 501, and a standard A.A.R. box car was conducted by the Division of Engineering Research, Association of American Railroads. The results of these tests, set forth in preliminary form in Division of Engineering Research report No. 64, issued on November 1, mark two distinct advances in the field of freight-car design, one of them specific and the other of wide general import.

The tests show clearly that full advantage can be taken of the superior properties of the high-tensile structural steels for weight saving in a car structure without sacrifice of capacity to withstand rough usage. As a matter of fact, the lightweight box car, notwithstanding that it weighs 10,000 lb. less than the 1932 standard box car, in comparison with which it was tested—a reduction in weight of 22 per cent—withstood higher impact speeds before stresses were recorded which exceeded the yield point of the Cor-Ten steel than the A.R.A. car could withstand without exceeding the yield point of carbon steel at certain locations in the structure.

This should not be interpreted as a reflection on the A.R.A. standard design. These tests, as well as earlier impact tests, all indicate this design to be well balanced and probably about as highly refined as can be expected using carbon steel and fabricating by riveting.

The results of these tests would seem definitely to remove any question as to the practicability of the use of the higher-strength materials in thin sections and as to the effectiveness of welding as a means of producing a structure capable of acting as a unit under the severest kind of punishment. Of wide general import is the use made of the de Forest strain gages in determining stresses at 125 locations on the lightweight car. As the report points out, the results of the extensive data obtained in these tests have already cleared up certain points with respect to the action of the car structures in service which it has been impossible previously to know with certainty. Such a determination is the fact that combined stresses due to the dead load of the structure and the live load of the lading when the car is standing are very much lower than those due to horizontal impact, a condition which prevailed even when the horizontal impacts occurred at low speeds. The extensive use of these strain gages in design checking will prove invaluable in hastening and cheapening the process of perfecting new designs. By their use a balanced design can be achieved without the trial-and-error method of observing failures in service before determining the points which need strengthening to bring the design into balance.

The new technique of determining stresses at numerous points in a structure under impact removes a wide area from the field of uncertainty with which equipment designers now have to reckon.

New Tools Needed To Prevent Losses

One fact clearly brought out during recent months when the railroads experienced traffic volume approaching 900,000 cars per week was that they were gradually reaching a point where the lack of equipment buying during the depression years was beginning to show up the inability to handle traffic economically. This was indicated by the necessity of bringing back into service motive power that, by comparison with modern power, is certainly to be considered obsolete and by the fact that the increasing pressure of repair work on the shops made it obvious that many of the older units of shop equipment are no longer adequate to meet the demands of production volume and quality workmanship. Many roads took advantage of increasing income to start programs of shop rehabilitation by the purchase of new equipment to replace the obsolete units. The present recession in general business, resulting in traffic decreases, and the awarding of wage increases to railroad labor have combined to slow up these programs of equipment buying and have resulted, in addition, in curtailment of employment, and, consequently, repair work.

The continuance in service of mechanical facilities

which have outlived their usefulness as far as economical performance is concerned results in a decided loss, amounting to positive waste, to the company or the industry that is involved. A business, to be considered successful, must be operated at least within its income and a railroad is no exception. The prices which a railroad must pay for labor are fixed by agreement and the revenues are governed by rates and volume of traffic. When traffic volume decreases so does revenue and so likewise must expenditures. Under such circumstances it is possible for a railroad to pay for just so many hours of labor and the ultimate restoration of locomotive-miles to active service through the medium of repair work is in direct relation to the hours worked and—the adequacy of the facilities. In a well-equipped, well-supervised repair shop any given number of man-hours will restore more locomotive-miles to service than is possible in a poorly-equipped shop—no matter how well it may be supervised. In addition to the speed with which work may be performed there is also the very important factor of the quality of workmanship. This has a decided influence upon the amount of service that can be obtained from the motive power out on the road.

Conditions in many shops have reached a point where a substantial part of the shop equipment can definitely be classed as obsolete and is unable to perform the task of producing its expected share of work in relation to the amount of labor expended in its use. In other words, the obsolete tool makes it impossible for a workman to produce as much as his effort justifies.

Where a large part of the shop equipment inventory is made up of inefficient units it becomes increasingly difficult to maintain motive power and cars in condition for service at a cost within the ability of a road to pay. The result is under-maintenance and expensive delays to service. A policy which in the long run results only in the deterioration of a property through the inability to effect adequate maintenance is the surest way to bring about losses to both labor and capital. The roads should continue a program designed to replace obsolete equipment because, with limited revenues and increased costs, the necessity of assuring adequate maintenance at the lowest possible cost is more urgent than when the spread between income and expense is greater. Labor has a vital interest in the modernization of a property for a careful analysis of the effects of obsolescence will show that inadequate tools and equipment actually stand between the workman and his long-range interests. In a competitive situation they weaken the industry on which he depends for a livelihood.

Contrary to the belief that modern facilities wipe out opportunities for employment, expenditures for new equipment will have relatively little effect on the total amount distributed in wages. It will, however, have a decided effect on the amount of serviceability restored to locomotives and cars for every dollar expended for labor.

Intelligent reductions of operating costs through modernization are the best assurance that the railroads will continue to serve the public as successful private enterprises.

Is the Locomotive Inventory Adequate?

Throughout the past eight years since the beginning of the general business recession and, in fact, for several years prior to that time the number of locomotive units in the motive-power inventory of the Class I railways has steadily declined. From approximately 60,000 locomotives on line at the beginning of 1928, the number had dropped to approximately 43,500 this fall.

The removal of approximately 16,500 locomotives from the bottom of the inventory has not reduced the aggregate capacity at all in proportion to the number of units involved. The locomotives removed were mostly of ancient vintage and of relatively small capacity. Furthermore, during the years of declining traffic no question of the adequacy of motive-power capacity was raised by the declining number of locomotives because the drop in traffic volume was in so much greater proportion.

In 1928 and 1929 the average monthly mileage of active locomotives during the fall peak of traffic was 2,239 and 2,266, respectively. In 1929, 85 per cent of the total number of locomotives on line were in active service during the peak month. In October, 1932, the average miles per month of the active locomotives averaged 2,160. Furthermore, with over 10,000 locomotives stored and almost 9,000 out of service awaiting repairs, only 63 per cent of the total number on line were actually in service. A year later, with a slight increase in the total number of road-locomotive-miles, the average miles per active locomotive was 2,080 and the active locomotives during October of that year represented but 67½ per cent of the total number on line.

Coming to 1934, with practically the same total locomotive miles as in the preceding October, each active locomotive averaged 2,200 miles, and but 67 per cent of the total number of locomotives on line were in active service. In point of intensity of utilization of the active locomotives, the fall peak of this year represented a return to the conditions which prevailed during 1928 and 1929, but with 10,600 locomotives in unserviceable condition and with over 5,000 locomotives stored serviceable.

In October, 1935, with an appreciable increase in total locomotive-miles over the fall peak of the preceding year, there was a definite increase in intensity of utilization over that prevailing in 1928 and 1929. There was an average road locomotive mileage of 2,360 per locomotive in active service. No appreciable reduction had been made in the number of unservicable locomotives during that year, although the number of stored locomotives had begun definitely to shrink. At

that time the active locomotives represented 69 per cent of the total number on line.

In the fall of 1936, there was again a marked increase in road-locomotive-miles over the number recorded in October, 1935, and a further increase in intensity of utilization of the active locomotives is indicated by an average mileage of 2,460. The first marked shrinkage in reserve power was also evident at that time, as the number of unserviceable locomotives had dropped below 8,400 and the number of stored locomotives to considerably fewer than 3,000. The locomotives in active service represented 75 per cent of the total number on line. During the past year this percentage increased to 79 in October because of a still further reduction in the number of unserviceable locomotives, although the number stored serviceable has increased slightly during the latter part of the year as compared with the fall of 1936. The disappointing recession in traffic during the late summer and fall, however, resulted in a drop in total road-locomotive-miles and a return in point of intensity of utilization approximately to the figures of the peak months of 1928 and 1929.

The figures indicate that the reserve supply of motive power at the present time is barely adequate to meet a definite upturn in traffic when such an upturn comes, as it inevitably will. They do not, however, give any indication of the quality of the motive-power units themselves, either as to individual capacity or effectiveness to meet modern traffic conditions. Most of the motive-power units removed during the past ten years had long passed their effective life and a relatively small number of the locomotives at present on line have been installed within the past ten years. It can scarcely be doubted that further increases in the number of active locomotives will be by units still far from modern in adequacy and efficiency. It is probable that such further increases will lower the intensity of utilization which it will be possible to average as total locomotive mileage increases.

Do Roller Bearings Reduce Wheel Slip?

An important part of the cost of maintaining locomotives is represented in the expense involved in taking equipment out of service for the turning of driving-wheel tires. The mileage secured between tire turnings varies greatly with the class of equipment and type of service, the best performance in heavy fast passenger service usually ranging from 70,000 to 100,000 miles per tire turning. Not infrequently, however, excessive wear due to "quarter slip", the development of sharp flanges, or some other cause, reduces this mileage 50 per cent so that locomotive driving tires have to be turned after only 35,000 to 50,000 miles.

The subject of "quarter slip" is of great importance because of the attendant excessive cost of driving-wheel maintenance and the *Railway Mechanical Engineer* will be glad to receive for publication, constructive information regarding the causes and remedies for this condition. While the subject is generally familiar to locomotive maintenance men throughout the country, there is considerable difference of opinion, for example, regarding exactly where this uneven tire wear actually occurs and to what extent excessive wear in driving boxes and rods causes it.

An interesting comment in this connection was recently made by the mechanical department head of a large railroad who said that the application of roller bearings to the main driving wheels of a certain class of locomotive which had given considerable trouble due to "quarter slip" practically eliminated the difficulty and doubled the mileage between tire turnings. The explanation of this very desirable result was that accurate fitting of the roller-bearing boxes eliminated slack action such as is occasioned in worn plain bearings and consequently, had a tendency to prevent slippage of the driving wheels when the main crank pins passed the dead center. It would be informative to know if other roads have had a similar experience and whether or not roller-bearing rods are also a helpful influence in this connection.

New Books

IMPACT TESTS OF LIGHT-WEIGHT BOX CARS. *Summary Report prepared by the Division of Equipment Research, now the Division of Engineering Research, Association of American Railroads, 59 East Van Buren Street, Chicago. 54 pages. Price to member roads $1; to others $2.*

This report was prepared at the request of the A.A.R. Mechanical Division Committee on Car Construction, on April 1, 1937, and revised October 1, 1937. The report contains the result of impact tests conducted with two experimental light-weight cars, one, built by the Pullman-Standard Car Manufacturing Company, embodying the extensive use of welded Cor-Ten Steel construction and weighing 34,200 lb.; the other car, built by the Mt. Vernon Car Manufacturing Company, being also made of Cor-Ten steel but with riveted construction throughout and weighing 36,400 lb.

The report contains a brief description of the experimental test cars and tables of detailed comparative car weights in Part 1. A summary of the results of the tests is included in Part II and Part III describes extensometer and deflectometer tests of the Pullman-Standard car. Other sub-divisions of the report include: Part IV, Impact Test Procedure; Part V, Results of Impact Tests of Pullman-Standard Light-Weight Box Car; Part VI, Results of Impact Tests of Mt. Vernon Light-Weight Box Car; Part VII, Results of Impact Tests of A.A.R. Standard Box Cars (1933-1934); Part VIII, Distortion of Car Structures During Impact Tests; and Part IX, Performance of Experimental Light-Weight Box Cars.

Gleanings *from the* Editor's Mail

The mails bring many interesting and pertinent comments to the Editor's desk during the course of a month. Here are a few that have strayed in during recent weeks.

Rigid Locomotive Beds

What has the rigid bed contributed to the locomotive, outside of elimination of bolting and cross braces? Due to its remaining square, has tire wear been reduced, driving box and saddle wear reduced, and a general improvement in service of machinery resulted? Is there a possibility of eliminating waist sheets with the use of engine beds?

Accident Prevention

The safety movement and the promotion of safety throughout the shop, is of vital importance to a foreman, and perhaps of first importance in the performance of his duties. I would like to see more articles on this subject in the *Railway Mechanical Engineer*. There should be articles of practical and inspirational value. These, in my opinion, would be of great personal help to foremen in the field of accident prevention.

Thank You!

It is my opinion that the October, 1937, issue of the *Railway Mechanical Engineer* is the best issue which you have ever printed. I did not attempt to read it in the office, but took it home and read every article, and while many of our staff officers receive this periodical, I have called their attention to the fact that I would like to have each and every one of them spend sufficient time to thoroughly read and digest all of the articles contained therein. I certainly wish to offer to you my sincere congratulations.

Training in Public Speaking

I have joined a public speaking club which is to meet on Monday evenings throughout the winter, and the preparation of a little speech for these occasions has occupied quite a little of my spare time. I am hoping, once I have got some experience along this line, to avail myself of an opportunity now and again of speaking on railway matters, and perhaps in that way do something to bring before groups of people a more intimate knowledge of the working of the great transportation agencies, with the interests of which the lives and welfare of so many of the best of our working men are so inseparably bound up.

Finding Out About Essentials

You may be interested to hear that the Canadian Pacific Railway is now selling to its employees a Foundation Library of ten books at a cost of but two dollars, to assist its employees to gain a solid, clear understanding of the foundations upon which the whole fabric of our economic system is built, and with special emphasis upon just the part that our transportation facilities have played in the building. This was done to promote the spread of education amongst employees, in order that the men might have a clearer understanding of the factors involved when matters dealing with the relationships between management and men are under discussion.

Concerning Roller Bearings

Roller bearings are established, but I wonder what different roads are doing to maintain and replace them. Will they call on the manufacturers for replacement parts calling for finishes in ten thousandths of an inch, or will they undertake to furnish these parts themselves, with the possibility of requiring special machinery to carry on this work? Some of the roller bearings on axles of large diameter prevent the pressing off of wheels in the ordinary wheel press, and modifications in the usual method of pressing off wheels will be necessary. There appears to be a lack of information on the resistance of roller bearing locomotives, and without doubt such applications will make obsolete the old formula for locomotive resistances.

Antiquated Enginehouses

The mechanical department has always been considered a non-revenue part of the railroad make-up, and as but few operating officers have come from the mechanical department, they think in terms of modern locomotives when giving consideration to economies. The result has been that the railroads have gone exceedingly far in providing the American public with highly efficient locomotives. It is true that these locomotives reduce operating costs, but a good deal of the savings can easily be lost when these locomotives are placed in the roundhouse for having repair work performed. In other words, we have roundhouse equipment of 1910 attempting to handle locomotives of 1937. In my opinion railroads can increase revenues not alone by obtaining increased traffic, but also by reducing maintenance costs. If as much energy had been spent in reducing maintenance costs as has been spent in reducing operating costs, I believe the railroads would have made a much better showing in the face of reduced traffic.

An Investment and a Challenge

Anyone who will think seriously for a moment about the situation in which the railroads of the country find themselves, cannot help but be deeply concerned about their future. At the moment, much hope is being pinned upon relief by means of rate increases, but all hope should not be confined to this possible way out. There is another avenue open, which, if intelligently exploited, also offers substantial promise. What it all gets down to is simply this. Within the last several months the railroads have, in essence, agreed through the processes of mediation to invest an additional $135,000,000 annually in the service and good will of their employees. Their employees are effectively led and represented through 21 railroad labor organizations. It is through these organizations that the $135,000,000 pay increases have been accepted by the million and a quarter employees of the industry. Such being the case, what has the industry and the public a right to expect by way of improved performance, better service and increased efficiency, and how should industry and its employees go about securing the desired results? This, as I see it, is the challenge that confronts the railroads, their employees and labor organizations.

IN THE BACK SHOP AND ENGINEHOUSE

Performance of Vascoloy Tools in Boring Tires

An eastern railroad, believing that a rough and scaley finish at the wheel fit of driving-wheel tires might be the cause of progressive fractures resulting in tire failures, investigated the possibilities of boring the tires with a mirror finish by using Vascoloy-tipped tools. Experiment proved that it was impossible to obtain a polished finish with high-speed tool steel for the reason that such steel will not hold its edge at speeds in excess of 66 ft. per min., which speed resulted in relatively rough surfaces showing clearly the marks where the metal was torn at irregular points.

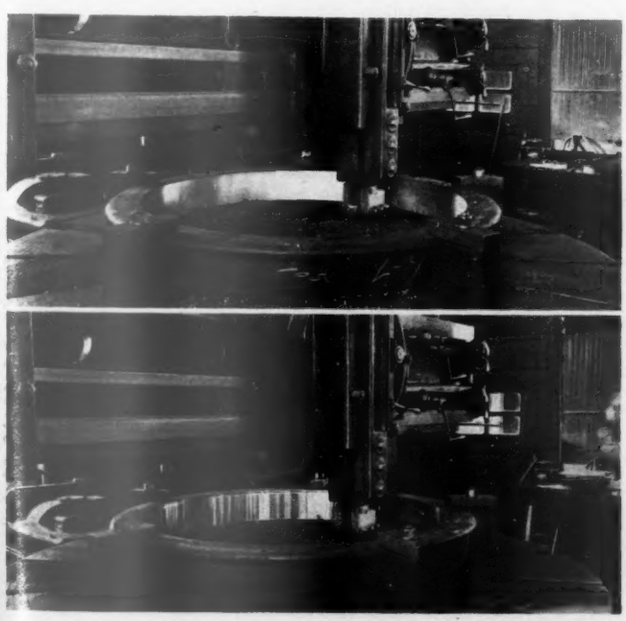
Performance of High-Speed and Vascoloy-Tipped Tools When Boring 50-in. Tires

	High-speed steel	Vascoloy tipped*
Tool		
Surface speed for roughing cut, ft. per min.	60	190
Feed for roughing cut, in.	3/32	1/16
Roughing cut, in.	1/16 to 1/4	1/16-1/4
Surface speed for finishing cut, ft. per min.	66	320
Feed for finishing cut, in.	1/16	1/16
Finishing cut, in.	1/16	1/16
Tires bored per grind, roughing tool	3	7
Tires bored per grind, finishing tool	1	15
Cutting time per tire, min.†	47†	27†

* Style No. 12 Vascoloy-Ramet tool used for roughing cut; Style No. 16 used for finishing cut.
† Time includes boring tires and cutting retaining ring grooves.

Realizing that high-speeds were necessary to produce the desired mirror-like finish, this railroad is now using Vascoloy-tipped tools and is making roughing cuts at a speed of approximately 190 surface ft. per min., and finishing cuts at a speed of approximately 320 surface ft. per min. while boring driving wheel tires. The accompanying table compares speeds, feeds and the performance of high-speed tool steel and Vascoloy-tipped tools when boring 50-in. driving tires. The illustration shows a finish tire bored with high-speed tool steel and another tire bored with a Vascoloy-tipped tool; although the illustration indicates the mirror-like finish of the tire bored with a Vascoloy-tipped tool, the differences in the finishes as observed on the job is much more apparent, the finish obtained with Vascoloy being perfectly smooth while the finish obtained with high-speed tool steel is decidedly rough.

Although this particular application of cemented-carbide tools was made primarily to produce a finish which would eliminate what is thought to be one of the causes for tire failures, the results of the machining operations has proved the possibility of effecting economies in production methods by using these cemented-carbide tools. With the increase in surface speeds, the production of tires has been increased. Also, the number of tires bored per tool grind has been increased, thus effecting further economies in time used for changing and grinding tools on this particular operation.



Top: Tire finish-bored with high-speed tool steel. Bottom: Tire finish-bored with Vascoloy-tipped tool. This unretouched illustration was taken under actual shop conditions and without the aid of artificial lighting

Welding with Coated Electrodes*

By J. A. Coakley, Jr.†

THE broad use of electric-arc welding in the fabrication and repairing of locomotives and cars has been made possible by (1) the study of welding by the roads themselves with intelligent application of the process, and (2) the steady progress brought about through extensive research and development on the part of the manufacturers of welding equipment. The development which has probably done more than any other single thing to stimulate progress of welding has been the introduction of the shielded-arc method. Developed and progressively improved, the shielded arc has been a great aid in removing the doubt which existed for a long time regarding the strength of welded joints. This process made it possible to produce welds actually exceeding mild rolled steel in physical properties. For the sake of comparison, the physical properties of welds made with both bare and shielded-arc electrodes, are given in the accompanying table.

Physical Properties of Welds Made with Bare and Coated Electrodes

Property	Coated electrode	Bare electrode
Tensile strength, lb. per sq. in.	70,000	47,000
Ductility, per cent elongation in 2 in.	25	6
Density, grams per c.c.	7.84	7.6
Fatigue resistance, lb. per sq. in.	30,000	13,000
Impact resistance, ft.-lb. Izod	50-80	8-15
Resistance to corrosion	Greater than mild steel	Less than mild steel

Because of the improved results obtained by the

* Presented at the annual meeting of the Master Boiler Makers' Association at Chicago, September 30, 1937.
† Vice-President and Secretary, The Lincoln Electric Railway Sales Company, Cleveland, Ohio.

shielded-arc process of welding, safety is assured in welded construction and we find here the reason why electric welding is being employed increasingly by the railroads. All the world is watching with great interest the experimental tests which are being conducted by a large eastern railroad in conjunction with one of the locomotive builders in an effort to determine the practicability of an all-welded locomotive boiler which has been fabricated largely with shielded-arc electrodes. It might be mentioned here that great attention is being given to the subject of stress-relieving of welded joints on this particular job in an effort to determine whether

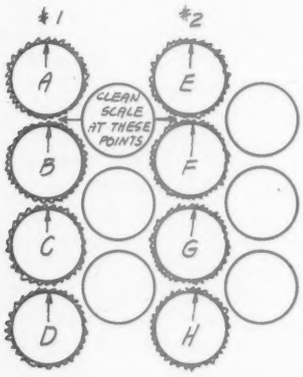


Fig. 1—Section of flue sheet illustrating flue-welding procedure

or not this procedure is necessary, and if so to what extent and through what means.

One simple fact accounts for the greatly improved physical properties of shielded-arc welds (those made with coated electrodes). In the shielded-arc process, the coating of the electrode, as it is consumed in the arc, produces a gas which envelopes the arc and weld metal and protects it from the surrounding atmosphere which contains oxygen and nitrogen. This protection prevents formation of oxides and nitrides as it is the presence of these impurities in unshielded-arc-weld metal which embrittles and weakens the welds. The improved quality of the welding is not the only advantage provided by the shielded-arc process. The other result—and the one

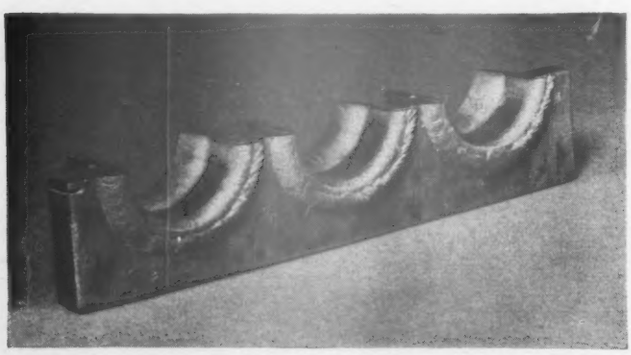


Fig. 2—Section of flue sheet in which the tubes have been welded with both bare and coated electrodes

which accounts for the greater economy of modern electric welding—is the effect on welding speed.

Savings with Coated Electrodes

Each day boiler men on the railroads are becoming better acquainted with the advantages which are found in the use of coated electrodes. However, many roads because of lack of funds have not been able to increase the number of welding machines in their shops in proportion to the greater demand for this additional equipment and it has fallen upon the men in charge of getting the work out to make a more efficient use of the facilities at hand. It can safely be said that there is no other means which will aid them more readily in the accomplishment of this end, and at the same time with no additional expense, than that which is afforded by the use of the shielded arc electrodes. The author will attempt to show later how the cost of welding can actually be reduced with this type electrode, but for the present will consider only the savings in man-hours alone.

It is conservative to say that there will be savings of at least 30 per cent in man-hours employed if coated electrodes are used in connection with the welding of flues and tubes to the back flue sheet of a locomotive boiler. Here are figures from an actual application on a midwestern road. A locomotive with 261 flues and tubes was welded in 8½ hrs. using a $\frac{5}{32}$-in. coated electrode. It was learned later that it had previously taken from 18 to 20 hrs. to weld this same set of flues with bare rods. Another example is of a locomotive boiler having 253 2-in. flues, 36 superheater flues, and eight 2-in. air tubes which was welded in 7 hrs. 15 min.; 18½ lbs. of $\frac{5}{32}$-in. coated wire were used. There are some railroads on which it is a practice to weld flues with ⅛-in. electrode, and with this diameter wire a set consisting of 244 2¼-in. flues and 53 superheater flues were welded in 8½ hrs. During a test which was made at the Collinwood shops of the New York Central System in December, 1936, one of the regular welders completed 45½ 3¾-in. flues in one hour.

While $\frac{5}{32}$-in. electrodes are usually employed for this work, mention was made of one instance in which ⅛-in.

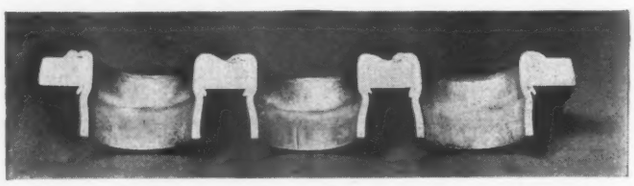


Fig. 3—The flue-sheet section from the side opposite that shown in Fig. 2—Note the porosity in the welds made with bare electrodes

wire was used, particularly where there are many 2-in. and 2¼-in. flues. One advantage of the ⅛-in. size is that it produces a rounder bead on the smaller flues. It also prevents overlapping of the welds at the bridges which are sometimes very narrow when small diameter flues are being inserted.

Using a $\frac{5}{32}$-in. straight polarity shielded-arc electrode it is possible to weld one 3-in. flue per minute and 10 flues in 10 min. Owing to interruptions for changing positions, etc., it will not be possible to keep up the rate mentioned until the entire set has been completed but the author has seen as many as 58 3-in. flues welded in one hour.

Preparation of the Work

1.—In preparing to weld with coated wire it should be seen at the outset that all the flues and tubes are properly applied. When old flue sheets are used it is necessary to have all of the old weld metal removed.

2.—When the flues are expanded it is recommended that soap be used as a lubricant for the reason that oil will create porosity in the weld metal. The heat of the arc seems to act upon any oil present, creating a gaseous condition in the molten metal which produces a porous state when the metal is cooled. Of course, some roads

use a solvent to clean the flues when oil has been used as a lubricant but the objection presented in such a case is that the cleansing compound does not get under the beads and any trace of oil which is not removed will cause porosity.

3.—Caution must be exercised to see that the copper ferrules are set back the proper distance from the face of the flue sheet, which in most instances is $\frac{1}{32}$ in. When the copper extends beyond the limit mentioned there is a great possibility of it becoming mixed with the weld metal which will cause hardness in the deposit and the result will most always be a cracked flue bead. It must be borne in mind that, with coated electrodes, it is necessary to use higher welding currents which, while affording greater speed, will also cause deeper penetration of the weld metal, making it quite necessary to see that the ferrules are inserted properly. This deeper weld is at the same time more ductile and has a greater resistance to shock and may possibly lead to the complete elimination of the copper ferrule.

Attention has previously been directed to a method of welding boiler flues to the back flue sheet which eliminates the use of the copper ferrule.* Certainly such a method is more adaptable to the use of coated electrodes.

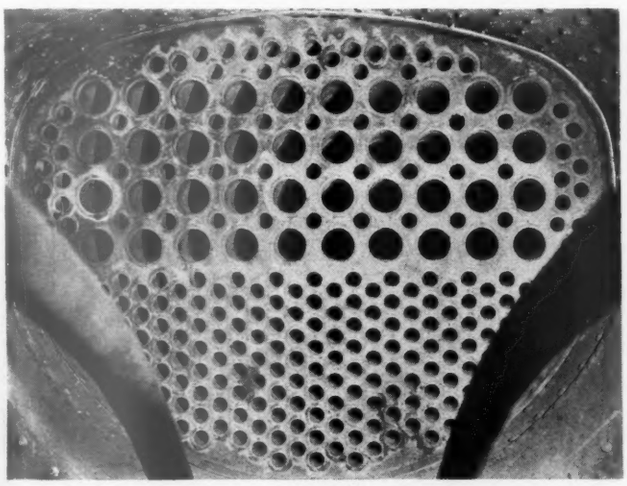


Fig. 4—Boiler flues welded with coated electrodes

In this method the holes in the flue sheet are beveled, the flues are then inserted to within $\frac{1}{16}$ in. of the face of the sheet and expanded. Then by using a special tool the ends of the flues are flanged onto the beveled sides after which they are welded. It is understood, however, that this method of welding flues will be successful providing water conditions are good.

4. Before the welding is begun it is recommended that the flues be sandblasted. This may be done before or after the flues are beaded but for a perfect job in which you want to be absolutely certain that there is no dirt, mill scale or other foreign matter present to impede the progress of the welding and cause impurities in the welds, it is better to sandblast before the flues are beaded. In certain instances, flues are not welded by some railroads until after the engines have been fired. If such be the case it is quite necessary that the entire flue sheet be sand blasted before welding is started.

Welding Procedure

Some railroads weld flues with water in the boiler in which case the heat is dissipated more rapidly than when the boiler is dry and it is possible to move along without making any allowance for the effect of the heat of the arc upon the flue sheet. Assuming, however, that most flues are welded with the boiler dry, (during which time care must be taken to see that the heat is not concentrated too long in any area on the sheet), the following procedure is outlined:

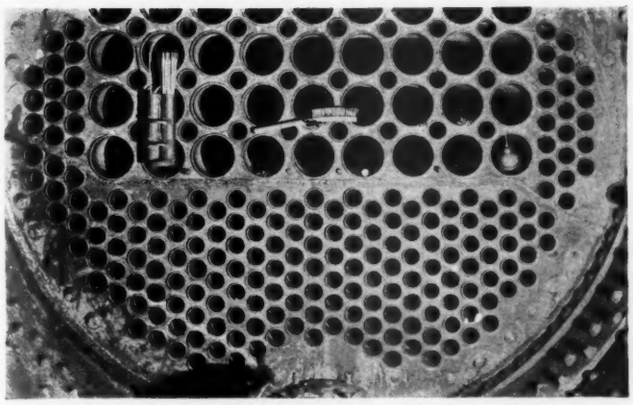


Fig. 5—A ¾-in. front flue sheet welded-in without removing rivets

1—Fig. 1 shows appearance of section of flue sheet with flues.

2—Start the arc on row No. 1 of flues at top of *A* proceeding downward to *B* and continuing *C, D,* etc., taking half a flue at a time. After welding eight or ten flues in this manner, jump over one or two rows and follow the same procedure as on row No. 1.

3—After row No. 2 has been welded, the first row of flues will have cooled sufficiently and the operator can go back, clean scale off welds at the top and bottom of each flue and weld the other half of the first row (*A, B, C,* etc.). When welding the second half, the weld should be overlapped at the top and bottom of the flue at least ⅜ in., or in any event enough to make certain that the fusion is perfect.

4—Skip over two rows from No. 2 to where No. 3 would be and follow the original procedure outlined previously in paragraph No. 3. Then return and finish the second half of row No. 2.

5—This procedure should be continued until all flues are finished. It is not necessary to clean the scale from the flue welds where no further welding is to be done as firing the locomotive will burn it off.

6—If the job is to reweld flues where the original weld has cracked, remove *all* of the original weld metal, clean the sheet and flues carefully, and proceed as previously outlined.

7—If the crack extends into the flue sheet, open up the crack and be sure to open it up at least ¼ in. beyond the apparent end of the crack, then V the crack in the sheet and proceed as for an ordinary butt weld. The weld bead should be as high as the flue bead and slightly rounded. It has been found the tendency of hollow beads is to crack. Where a bead cracks it has been found nine times out of ten to be due to one of two things: Either a shallow bead of weld metal or to the ferrules extending out too far.

In holding the electrode during welding it is advisable to direct the arc against the sheet rather than the bead of the flue. This keeps the heat away from the thin tubes and prevents cutting the metal. It is good practice to hold the electrode at an angle that will cause the flux to be blown backwards, providing a good clean weld. Good results are obtained when the electrode is held at an angle of 45 deg. to the flue sheet and an angle of

* "Safe-Ending and Applying Flues and Tubes," *Railway Mechanical Engineer*, October, 1937, p. 497, Fig. 3.

from 75 deg. to 85 deg. to the angle of the bead. Welding current a little higher than those ordinarily used is advantageous in this work.

The reason for the higher current is to insure an equal burn-off of both rod and coating as insufficient current will cause the rod to burn inside the coating. The operator can observe the flow of the coating on

Fig. 6—Firebox completely welded, ready for assembling in the shell of the boiler

top of the weld and determine whether or not enough current is being used. High currents assure good penetration and clean welds. Another thing to bear in mind is to hold an arc as short as possible, since a long arc tends to flatten out and cause a shallow weld.

Figs. 2 and 3 show two views taken of a sample flue-sheet section in which three flues have been welded—one side with bare electrode and the other side with coated electrode. After the welding was completed the section was sawed across the middle and etched in acid in order to show a comparison of the shapes and compositions of the metal in the beads produced by the two electrodes. The bead on the right, looking at Fig. 2, was made with bare electrode while that on the left was made with coated rod. Note the smoothness of the bead, the penetration and the homogeneous grain structure of the weld which was made with the coated electrode.

Fig. 3 shows porosity in the welds made with bare electrodes; note the absence of porosity in shielded-arc welds.

Welding of Side Sheets

The type of weld recommended in firebox side-sheet construction is the single vee butt weld using a 30-deg. bevel on both sheets. The fitup should be as uniform as possible and should not be less than ⅛ in. or more than 3/16 in. It is well to tack the two sheets with a small bead about every 12 to 15 in. along the seam to be welded. The first bead is usually deposited with a ⅛ in. electrode in order to insure proper penetration of the weld through to the water side where the weld should be clean and flush with the sheet. This is made certain on a new firebox by taking a round-nose chisel and Veeing the weld out on the water side after the weld on the fire side has been completed. After this has been done a single bead is deposited in the vee to create a smooth surface. When a patch is applied, this will not be possible and visual inspection of the water side of the weld through the staybolt holes will be necessary to make certain that perfect penetration has been obtained.

After the first bead on the fire side has been deposited with ⅛ in. electrodes, 5/32 in. rods can be used applying each layer across the entire length of the seam until the weld has been completed. Each layer should be thoroughly cleaned of all scale before another one is deposited.

Cost of Deposited Metal Should be Considered

Though the cost per pound of the shielded-arc electrode is somewhat higher than that of bare electrodes, the cost per pound of metal deposited will be approximately 30 per cent less, because the increased speed which is permitted with coated wire. In fact, if it were possible to receive bare rod free, it would still be more economical to purchase coated rod.

When welding in fire boxes, in addition to the faster speed and resulting economy, shielded-arc electrodes provide the highest possible quality of weld metal which assures a safety factor from 10 to 15 per cent higher than that possible with bare electrodes. This is due to the higher physical property of the weld produced by the shielded arc. It is greater in tensile strength, higher in ductility, more resistant to shock, impact and fatigue and at the same time it is more resistant to corrosion.

This is particularly noticeable when firebox sheets are being renewed upon examination and comparison of welds made with the two types of electrode.

Examples of Savings with Weldings

Following are some examples of the advantageous use of electric welding in reconditioning locomotive boilers:

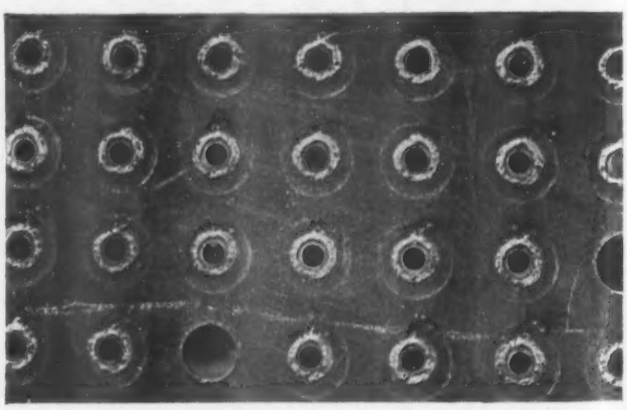


Fig. 7—Renewing staybolt holes by welding in tapered bushings, then drilling and tapping threads; 35 holes prepared per hour

Fig. 4 shows a set of flues welded with coated electrodes.

Fig. 5 illustrates a job which has seldom been done, and one which never would have been attempted without the assurance of high quality provided by coated electrodes. It is a ¾-in. front flue sheet welded in without removing any of the rivets. It was welded with coated electrodes in a series of small beads. Each bead was cleaned of all slag before the welder applied the next one.

Fig. 6 shows the outside of new firebox completely welded, ready for assembling in the shell of the boiler.

A new method of renewing staybolt holes is illustrated in Fig. 7. The old method was to fill up the worn holes with weld metal and then drill new holes and tap threads. With the old method, it was possible to do about 8 holes per hour. With the new method, 35 holes are done per hour. Procedure is as follows: The old hole is reamed to take a tapered bushing. The

bushing is welded in, using coated electrodes. Welding is started at the top, proceeding downward, welding first one half and then the other, cleaning slag off between. A large bead is not necessary as the taper takes care of the pull, the purpose of the bead being that of seal. The bushings are made at low cost and can be renewed simply by knocking them out and replacing them. Another advantage is that there is enough stock to put in an oversize staybolt if this is found to be a desirable procedure.

Traveling Material-Handling Wagons

A type of material-handling wagon now being used with satisfactory results at the New York Central shops at Beech Grove, Ind., is shown in the illustrations, one view indicating a single wagon especially equipped to handle air-brake material and the other showing four wagons designed for handling miscellaneous small materials used in locomotive repairs. These wagons are returned to the storeroom at the end of each day for checking and the replacement of depleted stock, and are sent to their respective shop departments on the following morning

Material-handling wagon used in the air-brake room

where necessary repair materials can be secured by shop men without delay.

Referring to the illustration, showing four material wagons, the general construction of this new type of wagon is readily apparent. It consists of an ordinary steel or wood trailer frame mounted on wheels and having a body made of scrap steel. The body is divided into three vertical sections, each of which has six evenly spaced shelves with three drawers or boxes per shelf. Each drawer or box is 6¾ in. wide, by 16½ in. long by 4¾ in. deep, the front end being tapered down to 3 in. for hand clearance. The end is turned over ½ in. wide, forming a handle. This gives a capacity of 54 drawers on each side of each wagon or a total of 108 drawers per wagon. Some of the drawers or boxes have several subdivisions for holding very small pieces of material, thus creating capacity for a greater number of parts. One wagon has approximately 600 bins for small parts of various kinds.

Materials handled in these wagons are those commonly required in every-day use for repairing and rebuilding locomotive parts in the machine shop, air brake room, boiler shop, pipe shop and erecting shop. Parts stored in these wagons include the following: Angle valves up to 1¼ in. diameter; cotter keys up to ⅝ in. by 5 in.; grate-connecting pins, all sizes; globe valves, ¼ in. up to 1¼ in.; hose clamps up to 1½ in.; all size hexagon nuts up to 2 in.; machine bolts up to 1 in. diameter by 12 in. long; pipe ferrules; pipe nipples from ¼ in. to 2½ in. up to 8 in. long; pipe unions, ¼ in. to 2½ in.; pipe ells, ¼ in. to 2½ in.; pipe tees, ¼ in. to 2½ in.; all other miscellaneous pipe connections up to 2½ in.; all sizes and lengths of standard and steamtight studs; all common washers up to 2 in.; and staybolt sleeves and caps.

On the wagon used in the air-brake department, which has a separate compartment on either end for storing air-pump metallic packing rings of the various dimensions, such items as the following are carried: Parts for No. 9 and No. 11 Monitor injector; parts for No. 11 and No. 13 Simplex injector; lubricator parts, reverse-gear parts; water-column manifold parts; safety-valve parts; BK and Duplex stoker parts; feedwater pump parts; blow-off cock parts; air reverse, water pump and stoker packing of various sizes, and many other miscellaneous parts too numerous to quote.

Previous to the installation of these wagons, mechanics, helpers and material messengers made individual trips to the storehouse when requiring material of any kind. This required anywhere from 5 to as much as 30 minutes time, depending on the distance necessary to walk and, perhaps, congested conditions in storehouse. After the wagons were installed, this time was cut to a minimum of not over two minutes from any location in the shop, as the workmen, when requiring material, now walk to these wagons and obtain only the material they are going to need on a particular job, thus saving a considerable amount of money due to the fact that previously excessive materials were drawn from stock in order to save time and some, no doubt, found their way into the scrap.

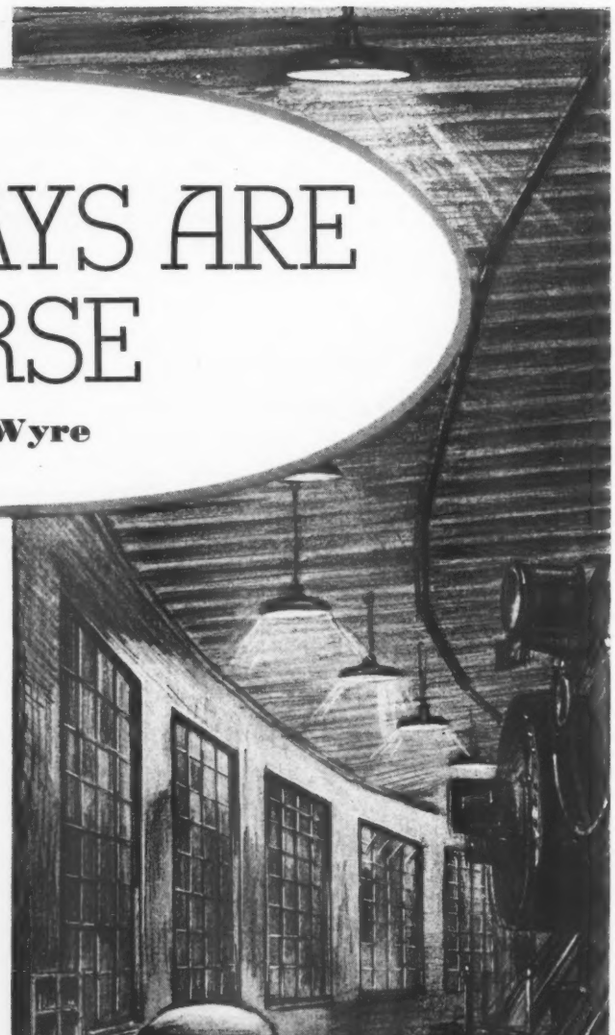
About 2 p.m. each day the accumulated orders from the previous eight hours' business are sent to the store-

Traveling material wagons which are used successfully at Beech Grove shops

house where they are checked and tabulated on forms made for that purpose and a like amount of material is made ready to be put back in these wagons when they are returned to the storehouse (about 4 p.m.) so that the wagons are ready to take care of the demand at 8 a.m. the following day.

SOME DAYS ARE WORSE

By **Walt Wyre**



THE S. P. & W. roundhouse at Plainville was enveloped in a gray, early morning fog that whirled and eddied in air currents around the buildings. An upward draft parted the fog like a curtain disclosing the smoke stacks of the stationary with the lower part hidden. The stacks appeared to be floating in thin air as though levitated by an invisible force.

Inside the roundhouse it was strangely quiet and the place, although full of locomotives, seemed deserted. The gentle hiss of steam from a leaky ball joint in a blow-down line and steady drip, drip of water accentuated rather than broke the silence.

The footsteps of Jim Evans, day roundhouse foreman, echoed loud on the cement runway as he walked rapidly towards the lineup board near the center of the roundhouse.

It was a few minutes past seven o'clock. The night force had gone home and members of the day force going to work at eight had not yet come on the job. Men that worked on three-shift jobs, fire builders, cellar packers, and such had their work caught up. They were hid out some place waiting for eight o'clock and time to go home. The seven o'clock machinist and his helper were making some last minute repairs on an engine on the outbound track outside.

The foreman laid the work reports for various locomotives on the home-made desk by the board, spread out as though he was dealing a hand of solitaire. On each work report a bunch of yellow work slips was fastened with a paper clip. He could tell by the thickness of the stack of slips on each work report what engineer had come in on the locomotive represented and which inspector had looked the engine over. The one with the big stack of about fifty items on the 5081, that would be engineer Hawkins. "Engine don't steam good —feed water pump won't supply the boiler—examine piston packing"—Evans knew without reading the report that those items would be listed. Hawkins can work an engine harder, get less out of it, and give more reasons for poor performance than any other old head engineer on the Plains division.

The foreman arranged the work slips in bunches for the various mechanics and placed them in pigeon holes above the desk. An occasional slip was consigned to the waste can and "O.K.—J.G.E." noted on the report. Some of the jobs thus O.K.'d should be done—Evans knew that, but trains won't run without power and there wasn't time enough to get all the work done before the locomotives had to run.

THE roundhouse had been quiet at seven o'clock. At 8:15 it was a noisy bedlam of moving men, roaring blowers, stacatto chatter of air hammers and other sounds that made a busy roundhouse seem to the uninitiated like a meaningless hurly-burly of nerve racking noise.

When the men were all lined up and the work well under way, Evans went to the roundhouse office.

"Despatcher wants to double-head 82 and he wants an engine for the pile driver to go to Brady," John Harris, the roundhouse clerk, told the foreman.

Evans groaned and started back to the roundhouse. As he walked he made mental notes of engine assignments. The 1846 could be used on the pile driver. He had figured on using it on the branch line local next day. Have to figure on finishing up the 1841 that was on the drop-pit.

The foreman marked up the 1846 for the pile driver and told machinist Cox to look the engine over and do what work was necessary.

"There ain't no air pump on the 1846," the machinist reported more emphatically than grammatically ten minutes later.

"Damn—" Evans swore and bit off a hunk of "horseshoe." "Never thought of that. The air pump was taken off to be used on the 2762 last week. Had to order some repair parts." The foreman headed for the air bench in the machine shop like the seat of his pants were on fire.

"How's the air pump off the 2762 coming along," Evans asked the air man.

"Torn down waiting on parts."

"When can I expect the air pump parts ordered last week? When you going to get some trailer wheels for a 5000?" Evans asked the storekeeper ten minutes later. "Parts for the air pump should be in day after tomorrow. Can't say about the trailer wheels," the storekeeper replied. "Thought you had an extra air pump all fixed up ready to go," the storekeeper added.

"You mean we did have one. What we have now is a cylinder casting for an air pump and it's ready for scrap. We robbed all the other parts for repairs. See if you can't rush them parts along." Evans started back to the roundhouse.

Nothing to do but take an air pump off a dead engine. That meant a lot of work. M. of E. costs were already running over and he had more work than men, but no other way out of it.

"Say, Mr. Evans, the storeroom hasn't got a middle connection brass for a 2700," machinist Jenkins told the foreman.

"Well," Evans pondered, "can't you use some other brass to make the bushing? What engine is it for?"

"The 2719," Jenkins told him.

"Let's go to the storeroom and see what they've got," Evans said.

"What's the matter? Brass foundries on a sit down strike or is it the store department?" Jim asked the storekeeper. "How about a middle connection brass for a 2700?"

"Used the last one yesterday, but—"

"Let me finish it," Evans cut in, half joking, half serious. "You'll have some in the next car! We've got to run engines today," he added.

"I'll wire for some shipped passenger," the storekeeper said. "How many will you need?"

"Order a carload and I'll figure on getting a couple." The foreman was measuring brass castings with a rule as he spoke.

One was too large inside, another too short, others too small outside. None in the storeroom could be used to make the needed bushing.

"What'll I do now?" the machinist wanted to know.

Evans measured another brass. "Take this one."

"It's too big inside," Jenkins interrupted.

"Yeah, I know, and take this one—"

"O.K.," the machinist said, "I see."

The machinist chucked the smallest of the two brasses in the lathe and bored it to fit the pin. He then took a cut off the outside of the brass. Next he bored the inside of the larger bushing so that the smaller one would fit tightly inside. Then the bushing was finished outside.

"Have you got the knuckle pin bushing finished for the 5075?" a machinist asked Jenkins.

"Not yet; about twenty minutes," the machine man said as he tightened a parting tool in the tool post to cut off the middle connection bushing.

"Hell!" the other machinist snorted. "Anybody can be slow! I've been stalling nearly an hour waiting for machine work while you fellows in the machine shop loafed."

"Yeah!" Jenkins retorted. "If I had ground in as many seat boxes as you have I wouldn't talk about anybody loafing. These new style laminated bushings take more time than the plain one-piece kind."

Things seemed to be going fairly well when the foreman took a turn through the roundhouse a few minutes before noon. He stopped at the drop-pit on his way back to the office. Ned Sparks, the roundhouse electrician, climbed down from the cab of the 5092.

The electrician was mad as a nest of hornets that had been bombarded with rocks. "That's a devil of a mess!" Sparks sputtered, jerking a thumb in the general direction of the locomotive cab.

"What's a mess and why?" Evans asked.

"Half the cab fixtures gone and the engine marked to be finished tomorrow!" Sparks snapped.

"Well, I guess you'll just have to get some new ones." The foreman reached in his jumper pocket for a pad of requisitions.

"That's just the trouble!" the electrician interrupted. "There ain't any new ones. I've had water glass and steam gauge light fixtures ordered nearly a month and haven't got them yet. Half of my time for the past six months has been put in swapping light fixtures from one engine to the other. Nearly every time I make a change some of the wires are too short and I have to put on new ones. Bet I've used enough extra wire to have bought all the cab fixtures needed."

"Take the fixtures you need off the 5089. She'll be tied up a while," Evans directed and went on to the office.

JUST as the twelve o'clock whistle blew, the outbound engine inspector rushed in the office like he was an hour late and a dollar short. "Injector won't work on the 5077!" the inspector panted. "She's called for 12:45," he reminded.

By that time the rush of men knocking off for lunch had reached the clock just outside of the office. The foreman stepped to the door and waited until machinist Cox came by. Cox is the best injector man at Plainville.

"See what's the matter with the injector on the 5077," Evans told the machinist, then hurried home to lunch.

"You'll have stomach trouble eating so fast," Mrs. Evans told Jim when he started eating as though the food would evaporate in the next few minutes if not eaten immediately.

"Yeah, I'll have stomach trouble of another kind if I don't hurry. I'll be out of a job and suffering with miss-meal cramps if we have a few more delays and failures," Jim told her between bites. "I've got to get back and see about an engine that's been called for a run at 12:45."

"Well, I don't see why you don't quit! Rushing and hurrying twelve hours a day! Why don't you find another job—something easier even if it does mean less money?"

"It just happens that all of the easy jobs on the railroad are filled, besides I'm too old to hire on some other job and too young to go on a pension." Evans kissed his wife, picked up his hat, took a chew of "horseshoe" and started for the door all in less time than it takes to tell.

"Did you get the injector fixed?" the foreman asked when he reached the roundhouse.

"Have to have a new injector tube," the machinist replied.

"Did you get one?"

"No, there wasn't any in the storeroom. I was just fixing to call you and ask what engine to take one off of."

"Rob one off the 5089. She'll be tied up a few days. I'll give the storekeeper a note to order a couple," the foreman added.

Ten minutes delay was charged against the roundhouse on the 5077. Not so bad if the train it pulled were the only one affected, but it wasn't. The fast freight had to meet other freights and passengers. Carefully circulated schedules would have to be hurriedly revised and officials are not friendly even to minor delays.

When the one o'clock whistle blew, the foreman went to the roundhouse. After seeing that every one in the roundhouse was lined up with plenty to do, he went to the storeroom to have a talk with Foster, the storekeeper. He found the storekeeper in his office checking a stock book.

"Just the man I wanted to see," the storekeeper announced when Evans came in. "When do you expect to use that booster gear? We've had it on hand nearly three months now and only used one in the past year. If you're not going to use it, we'll send it in."

"Well, I don't know. We're likely to need it most any time. Of course, we don't use many of them, but when we need one, we need it quick," Evans replied. "Looks like we should have one on hand for protection."

"If we did that with everything, just look at the money tied up. We have got to show turnover. It's like that driver spring for an 1800 that I sent back last week. It had been on hand eight months with none used. The stores department can't keep material on hand like that with no consumption."

"Yeah"—Evans fished in his pocket for his plug of horseshoe—"I used to keep material like that hid away, but can't do that any more. But we've got to keep locomotives running and seems to me that a few hundred dollars worth of material tied up is not as bad as several thousand dollars worth of locomotives."

"Mr. Evans," a machinist helper interrupted the conversation, "gimme an order for a driver spring for the 1841."

The foreman reached in his pocket for a pad of requisitions. The storekeeper stopped him. "We haven't got one. I just finished telling you that I sent the only one we had back."

Evans groaned. "Now what in the devil are we going to do. I've got to finish the 1841 to use on the branch line local tomorrow and we can't do it without a driver spring."

"If you had told me day before yesterday—"

"Yeah, if we always knew thirty days in advance what we were going to need and when we were going to need it, it wouldn't be any necessity for a storeroom. We could order material in advance and use it when it came in. Now we'll have to do one of two things, run the engine with a broken spring or use a bigger engine that we can't spare on the branch line local."

"Like I told you, we can't keep unused material on hand. I'd get in trouble if I did."

"And I get in trouble if you don't have it when I need it. When you going to get a set of tires for the 5061. Hers are worn past the limit and thinner than a boilermaker's alibi for laying off on pay day."

"Ought to be in by the last of the week," Foster replied, "and half a carload of brass, too." The storekeeper anticipated the next question.

"O.K., order a driver spring for the 1841 by wire. We haven't got anything to rob one off of," Evans flung over his shoulder as he left the storeroom.

The balance of the day went along about as usual. The foreman covered more miles than a mail carrier and answered more questions than a bureau of information. In between times he wrote requisitions for material, assumed responsibility for running locomotives with reported work undone and stayed one jump ahead of the despatcher on engine requirements. The latter was the greatest feat of all and accomplished only because of intimate knowledge of the condition of every engine. He even subconsciously took into consideration the engineer that would be pulling the throttle.

At four-thirty the 1846 had steam and ready to go. She was called to run at 7:00 p. m. The electrician climbed up in the cab and turned on the steam to the turbo generator. There was a rushing hissing sound of steam when Sparks opened the dynamo throttle instead of the siren-like crescendo wail of a normally operating turbine.

The electrician's first thought was that some one had removed the governor valve cap. He climbed out on top of the boiler to see. No, the valve cap was still there and tight. He opened the dynamo door. Armature and field coils were in place but the armature turned lightly when grasped by the commutator and given a twist.

The electrician climbed down and rushed to the electric shop for tools. He removed the head from the turbine. The wheel was entirely gone. Evidently it had been robbed at night or at some other time when he was not there. The head had been replaced and outside appearance gave no indication of the wheel being gone.

"Why didn't you tell me sooner?" Evans asked when Ned told him about the dynamo.

The electrician explained that he didn't know about it himself.

"Well, get one from the storeroom and put it on. More overtime!"

"But there isn't any in the storeroom. The dynamos on the 1800's are different from the others, older type."

Evans swore again. "We'll take one off the 1841. I'll have to figure on using some other engine on the branch line local."

At 6:30 all was peaceful and calm in the roundhouse. The house full of locomotives seemed deserted. The foreman's footsteps echoed loud on the cement runway as he walked through the house gathering up work reports preparatory to going home for the day. As he

walked he pondered. At least one-fourth of the time charged to repairs that day was because of not having the exact material available at the instant needed. Yet the storekeeper was following instructions.

Evans went to the office. He had finished washing and was ready to go when Bob Parker, the night foreman, came in.

"How's it going?" Parker asked.

"O.K., I guess," Evans replied. "See you in the morning at seven."

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Welding Studs to the Boiler

Q.—Is it permissible to weld studs to a locomotive boiler instead of tapping the sheets?

A.—The practice of welding studs to the boiler is permissible on the firebox wrapper sheet, back head and throat sheet, these sheets being supported by staybolts, also on the smokebox, which is not under pressure. The writer would not recommend the welding of studs to the shell of the boiler due to possible injury to the sheet which might be caused by lock-up and excessive localized stresses be set up in the shell by such welding.

Weight on Trailer Truck of Belpaire And Radially-Stayed Boilers

Q.—For a given boiler power, does the Belpaire or the radially-stayed boiler place the heaviest weight on the trailing truck? —K. F. G.

A.—This of course depends entirely upon the design of the boiler. More or less weight could be placed on the trailer truck of either of these types of boilers by shifting the center of gravity. A comparison of engines already built, having the same general dimensions, shows that the engines having the heaviest weights on the trailer trucks are those equipped with radially-stayed boilers.

Nickel Alloy versus Carbon Steel

Q.—What advantages, if any, has nickel alloy steel over carbon steel for use in locomotive boiler work?—B. A. D.

A.—In modern high pressure locomotive boilers higher elastic properties and strength are required than those of low carbon unalloyed steels. The strengthening of the steel at atmospheric and elevated temperatures by additions of nickel instead of by carbon increase has the following advantages:

The nickel steel has much greater ductility, toughness and resistance to shock. These qualities are essential in coping with service stresses in the usual riveted construction.

Nickel steels are stronger at elevated temperatures than carbon steels with corresponding carbon contents.

The nickel steels resist aging embrittlement, an undesirable effect encountered in carbon and some alloy steels as a result of the "cold-working" necessarily imposed in the customary operations of boiler construction.

Low carbon steels with about 2 per cent or more of nickel combine initially high toughness with a high degree of resistance to grain growth in recrystallization. They tend, therefore, to maintain their initially high toughness and are less sensitive to certain deteriorating influences in boiler construction technique than carbon steels.

Under some conditions the nickel steels will show better corrosion resistance than the carbon steels.

With the use of nickel steel, which has a high tensile strength, the weight of the boiler can be materially reduced or the boiler pressure can be raised without increasing the weight of the boiler.

Pneumatic Tool for Nuts, Caps and Plugs

A pneumatic-tool development by the Independent Pneumatic Tool Company, Chicago, combines the action of both a hammer and a wrench for removing and applying nuts, flexible-staybolt caps and washout plugs. This tool, called the No. 603 "Hamerench," operates horizontally to the nut or cap, and therefore can be used where working space is limited. In addition to the No. 603 "Hamerench" this company has developed a larger tool, designated as the No. 604 "Hamerench" for use on superheater units, 1¾-in. nuts and other heavy types of work.

The principle of operation employed in applying and removing nuts involves direct rapid hammer blows, delivered at right angles to the nut, which produces a rotating action for spinning the nut at high speed. The force of torque is not employed, so that there is not the dangerous shock to the operator that comes from using the torque principle.

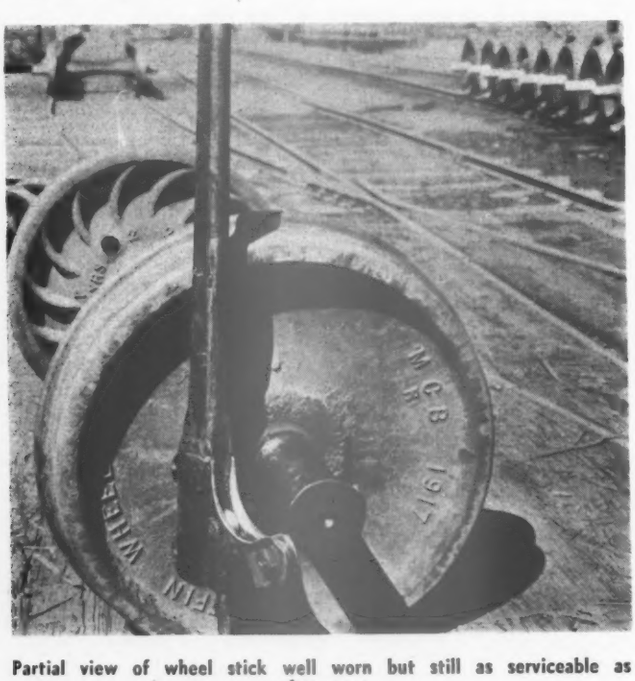
The "Hamerench" has been designed to remove and apply all sizes of nuts up to 1⅛-in. However, the tool can be furnished for larger sizes, such as flexible staybolts of all sizes, expansion-bolt caps, washout plugs, and similar applications. The "Hamerench" delivers 1,800 blows per min. and works in an 8-in. space. It is 22½-in. long overall, weighs 25 lb. and has a 1-in. square shank. Equipment supplied includes a hexagon chuck which is 1⅝-in. across the flat.

The Thor No. 603 Hamerench for removing and applying nuts, staybolt caps and washout plugs

With the Car Foremen and Inspectors

Ball-Bearing Wheel Stick

The ball-bearing wheel stick illustrated, has been used for some time on the Northern Pacific with very satisfactory results owing to its light but strong construction and the ease with which it permits car wheels to be turned at wheel shops and car repair points. An important feature of the design is the provision of two ball bearing rolls which support the wheels from the axle



Partial view of wheel stick well worn but still as serviceable as when new

collar and thus avoid any possibility of scoring the journal as well as greatly reducing the frictional resistance to turning.

In the construction of this wheel stick two rolls are mounted on second-hand headlight ball bearings which are supported in a pair of pressed steel brackets, the top edges of which are rolled to assist in locating the axle collar without danger of contacting the journal or scoring the collar fillet. The wide ends of the brackets are separated and shaped to receive the tapered end of a substantial fir handle, which is held securely in place in the brackets by means of two ⅜-in. carriage bolts.

Supports for the roller bearing brackets is provided by two tapered ¾-in. pipe sections, welded to one bracket only, and separated at the bottom by a short section of 1-in. pipe to which they are securely welded. This 1-in. pipe section, centrally located with respect to the wheel stick, serves as a guide for an adjustable 1-in. by 5¼-in. steel pin which provides a bearing point for the wheel stick and may be adjusted to one of three positions, dependent upon whether wheels are being turned on a hard shop floor or possibly at some outlying point on more or less loosely-packed earth where the wheel stick has a tendency to sink into the earth under the weight of the wheels.

This wheel stick has ample capacity for use in handling car wheels with axles up to 6 in. by 11 in.

Investigation of Wheel-Shop Practice*

By W. J. Fitzsimmons†

In the report of the Wheel Committee of the A.A.R. presented at Atlantic City this year, a paper was read tabulating defects causing removals on three different roads. It is expected that next year the committee will have considerably more data on this subject. Also, in several instances recently, attention has been called to defects occurring in early life of wheels placed under new equipment. Further, private-car lines are complaining of a large number of set-outs because of chilled-wheel removals for defects occurring long before ultimate life is reached.

The car-wheel manufacturers have, of course, recognized their portion of the blame, particularly for seams and worn-through chill, and are making every effort to eliminate these causes. On the other hand, even casual observation of chilled wheels under cars shows evidence in a good many instances of improper mounting practices.

In order to establish definitely just what the general practice was and to trace, if possible, the source of many so-called service defects, a recent check has been made of a number of shops in the Chicago area. A few of the larger shops were found to turn out excellent work, but a surprisingly large number were found to be breaking almost every rule of good shop practice. We have listed herewith the result of inspection of six shops taken at random, among which are represented car builders, private car owners and railroad shops. We have identified these shops by letters *A* to *F*, inclusive. We wish to particularly call attention to items which we feel would directly result in service defects.

It will be noted that all the shops listed bored wheels off center ranging from 3/32 in to 3/8 in. This condition in itself could well cause almost any defect but a seam or worn through chill. Throughout the life of the wheels, they would be subjected to uneven breaking, tending to cause slid flats, brake burns and shell outs. If they survived these defects, the constant pounding due to out-of-balance might well result in broken rims or even a broken wheel; also, inasmuch as both wheels on an axle would not necessarily be mounted out of center at the same point, the wheels would travel a zig-zag course, causing flange abra-

* Paper presented at a technical meeting of the Association of Manufacturers of Chilled Car Wheels, held at Chicago September 21 and 22.
† Service Engineer, Griffin Wheel Company, Chicago.

sion and strain resulting in a thin, vertical or even broken flange.

In addition to boring wheels off center, several of the shops listed bored them as much as ⅛ in. out of true with the flange. It would be few, indeed, of these wheels if they survive slid flats or brake burns in their early life, which would not be ultimately removed for flange defects.

The axle-lathe and wheel-press work were found to be equally bad. Wheel seats were either not burned at all or turned with a taper or out of round. Journals were turned with taper or rolled improperly. Wheel seats were guessed at, calipered or "miked" incorrectly. It cannot be otherwise than that a large number of wheels mounted with such practice would eventually be removed because of oil seepage, loose on axles or cut journals. It is little wonder that one of the shops checked had 150 truck sets sent back because of cut journals developing shortly after they went into service. Further, wheels mounted on axles or wheel seats out of true only aggravate conditions caused by wheels bored off center.

Undesirable Conditions Discovered in Six Car-Wheel Shops

Shop A

Boring Mills.—Wheels bored 3/32 in. off center; ⅛ in. out of true.

Axle Lathe.—Wheel seat turned with .004 in. to .009 in. taper. Journal turned .004 in. to .023 in. taper. Axles rolled in roll machine with bad centers; also bent spindle.

Wheel Press.—Recording gage and mounting gage in bad shape. Wheels spaced from back of flanges and checked with mounting gage.

Practice.—Wheel sticks used on journals for turning pair of wheels. Wheels bored same size were mounted on wheel seats varying .003 in. to .004 in.

Shop B

Boring Mills.—Wheels bored ¼ in. off center. Two tapers of .005 in. each, small in middle of hub and .004 in. out of round. Boring bar .015 in. loose in housing. Four of the five jaws holding wheel.

Axle Lathe.—Wheel seats turned with .013 in. taper small at dust-collar end and .004 in. out of round. Journals turned with .013 in. taper.

Wheel Press.—Ten tons' difference between indicating and recording gages. Wheels are spaced on axles with small piece of wood.

Practice.—Mike axles and caliper wheels. Wheels are fitted .012 in. to .014 in. tight.

Shop C

Boring Mills.—.001 to .003 in. taper large at front hub. 3/16 in. off center. Finish cut fed by hand. Finish cut did not go through hub. Three-jaw machine ⅛ in. out of true.

Axle Lathe.—.004 in taper. Small at dust collar end.

Wheel Press.—No recording gage used. Both wheels pressed on at one time. The wheels are gaged at one place only.

Practice.—Wheels fitted with calipers and tolerance estimated by holding calipers up to a light. Wheel seats are not turned.

Shop D

Boring Mills.—Three-jaw machine single cutter. One broken jaw welded crooked. Bores wheels ¼ in. off center. .003 in. taper large at back hub.

Axle Lathe.—Engine lathe used. 1/16 in. bent spindle. Bad centers. All axles turned run out of true from 1/16 in. to ⅛ in. .005 in. to .007 taper.

Wheel Press.—This machine has a 14-in. ram. Recording gage is for machine with a 9-in. ram and does not record correctly.

Practice.—Wheel fitted with calipers estimated .010 in. Actually .013 in. to .016 in. Mounted wheels are gaged at one place only. Wheel seats are not turned.

Shop E

Boring Mills.—⅛ in. out of center. .005 in. to .008 in. out of round. Taper from .003 in. to 018 in. Three-jaw machine, loose table, single-tool boring bar which is adjusted with hammer wedge. Boring-bar sleeve .020 in. loose in housing. Bores were small at the face hub.

Axle Lathe.—O. K.

Wheel Press.—Indicating gage but no recording gage.

Boring Mills.—Three-jaw machine single cutter. One wheel blocked up on two sawhorses to be pressed on.

Practice.—Wheels are fitted with calipers and are estimated to be .008 in. tight. Check with micrometers showed tolerance .013 in. to .016 in. tight. Wheel seats are not turned. Wheels counterbored ⅝ in. deep instead of ¼ in.

Shop F

Boring Mills.—Three-Jaw machine in bad shape. Single-tool boring bar. Tools don't fit bar; one side of tool does all the cutting. Tools improperly ground. Wheels bored ⅜ in. off center, ⅛ in. out of true with flange.

Axle Lathe.—Rollers have ⅛-in. fillet on one side and ¼-in. fillet on the other side.

Wheel Press.—Wheel press 3 in. low at one end, causing axles to spring 3/32 in. Twenty tons' difference between recording gage and indicating gage. Gages were last checked six years ago.

Practice.—Mounting gage worn ⅛ in. Journals not protected when pressing on. Wheels fitted with calipers held up to the light to estimate tolerance. Check with micrometer showed tolerance ranged from .006 in. to .023 in. Wheel seats are not turned. Wheels spaced on axle with small piece of wood from end of axle to back of hub.

Decisions of Arbitration Cases

(The Arbitration Committee of the A.A.R. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Repacking Journal Boxes Within Date

On November 19, 1934, the Seaboard Air Line repacked all the journal boxes on a Southern car three days before the expiration of the time limit, to the charges for which the Southern took exception. The Seaboard, while admitting the work was performed prior to the expiration of the time limit, declined to withdraw the charge, stating that in another case it had been required to accept a charge from the Virginian for cleaning air

brakes one day before the expiration of the time limit. The Southern contended that in the case of the Seaboard Air Line versus the Virginian the Arbitration Committee only suggested that the Seaboard accept the charge and that this was not done to establish a precedent to perform such service two, three, four or any number of days before the time limit expires.

The Arbitration Committee stated in a decision rendered November 12, 1936, that "The principle of Decision 1748 applies. The contention of car owner is sustained."—*Case No. 1751, Southern versus Seaboard Air Line.*

Wheel-Handling Device

An unusually simple and satisfactory device for handling car wheels from standard-gage material supply tracks to all repair tracks in freight-car-repair yards and shops, is shown in one of the illustrations. The principal advantage of the device is that it permits easily sliding a pair of wheels lengthwise from one track to the other, with slight manual labor and without the necessity of turning the wheels with a wheel stick, rolling them to the other track and returning them, all of which involves quite heavy manual labor and possible marring of the journal with the wheel stick. An additional important advantage is the facility with which a pair of wheels may be slid under a loaded car in the train yard or elsewhere with minimum jacking and small space between cars. The particular wheel-handling device shown in the illustration is used at the Danville, Ill., freight-car-repair yard of the Chicago & Eastern Illinois, and similar devices are used at five other points on this railroad, where freight-car maintenance is carried on.

Referring to the illustration, the general construction

Wheel-handling device used at car repair points on the Chicago & Eastern Illinois

of the device will be readily apparent. It consists simply of two lengths of 1¼-in. extra-heavy pipe, spaced on 11-in. centers and held in a fixed position by welded cross straps made of ¾-in. by 2-in. iron. The pipe-section track is 17 ft. 6 in. long, but when necessary to extend the pipe sections over two or more tracks an additional section of 17-ft. 6-in. track can be readily joined to the first by means of dowel-and-pin connections. Two dollies are furnished with each track section, each consisting of a welded steel framework designed to support the weight of the car wheels and operating on four flanged dolly wheels which roll on the pipe tracks. Each dolly framework is low-hung so

Method of cleaning rust-preventive coatings from car axle journals using distillated and fiber brushes

that the car wheels have to be raised only about 2¾ in. on tapered oak wedges to roll from the standard-gage track to the dollies. Transverse movement of the wheels to the other repair track is then accomplished with considerable ease.

The second illustration shows the operation of cleaning car wheel journals as they pass the oil house to the material-delivery track at the Danville shops. Protective material on the journals is removed by the use of distillate and a fiber brush, as shown in the illustration. Viscosity axle coating grease No. 5 is used for the most part in protecting the journals against corrosion and this material is readily removed by use of the distillate mentioned.

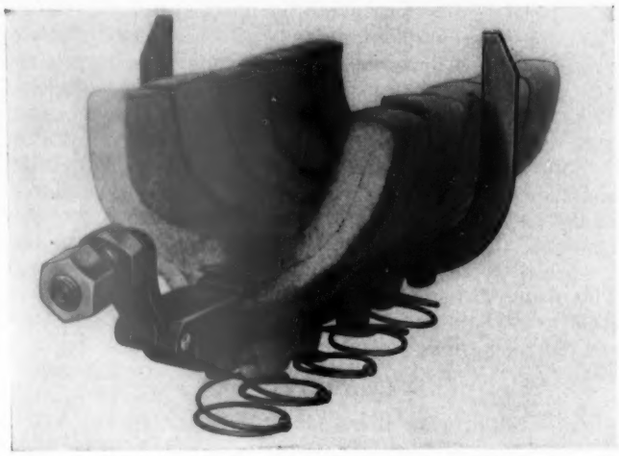
Miller Felpax Lubricator

A journal lubricator incorporating multiple-wool sections, designed for use in conventional journal boxes of diners, baggage cars, other passenger train cars or tenders, has recently been developed and placed on the market by the Miller Felpax Company, Winona, Minn. Road service tests of this lubricator have been conducted during the past 18 months or more with successful results under unusually severe winter conditions. The lubricator is also said to be well adapted for service on equipment operating through desert country where high temperatures and dust storm conditions are encountered.

The multiple wool sections of the lubricator, as shown in the illustrations, are shaped to fit the underside of the journal against which they are held by spring pressure from the bottom of the journal box. Two small semi-circular spring steel wires, imbedded in each wool section, assure the maintenance of full contact with the underside of the journal. The sections are interlocked in a simple manner and bolted to the front of the journal box, as illustrated, to prevent shifting. A U-iron, fitting between two of the sections, further prevents rotative movement. The lubricator sections are made of high-grade virgin wool so shaped that the end fibers are in contact with the journal, thus tending to prevent glazing and providing maximum capillary action. Four lubricator sections are required on 5-in. by 9-in. journals and five on all larger sizes up to 6½ in. by 12 in.

The Miller Felpax lubricator can be easily applied to

or removed from any standard journal box without jacking. No special tools or skilled help are required in the application which cannot be made incorrectly. Ordinary car oil is used as a lubricant, being applied in



Miller Felpax car-journal lubricator ready for application

the journal box to a maximum depth of about 1 in. Experience in the road service tests mentioned indicate that the lubricator operates without glazing or noticeable wear and with a journal temperature appreciably lower than with waste-packed boxes.

Additional advantages claimed are complete lubrication over the entire brass, minimum bearing wear, elimi-

Miller Felpax lubricator applied in a standard journal box

nation of waste grabs and glazing, reduced oil consumption, minimum inspection and attention enroute. Moreover the lubricator need not be removed for examination except at the time of wheel change. Rebrassing is done without touching the lubricator. If desired, the lubricator can be removed sectionally in a few minutes. Repacking during the winter due to soggy packing is eliminated.

In routine winter servicing, snow at the lid of the journal box is removed in the usual manner, however, some snow and ice remaining in the bottom of the journal box is said not to affect the lubricator. A small amount of car oil is added to the box about once weekly, for the best results. It is said that tests conducted last winter showed no need for additional servicing of passenger-car journals equipped with this lubricator, even in the case of 36-hr. lay-overs with the thermometer at numerous times registering 20 deg. below zero.

Selecting Satisfactory Freight Cars for Commodity Loading*

The selection of cars for commodity lading is of vast importance, and great responsibility lies on the shoulders of car men in so far as the condition of car as to mechanical conditions, construction and cleanliness is concerned. Traffic conditions have changed so rapidly and demands made by the traffic departments and public that it becomes necessary for the successful operation in the proper organizing and systematic planning of the work. This requires close co-operation between car, transportation, operating and traffic departments; constant supervision over empty cars; proper and prompt mechanical inspection and commodity classification; proper utilization; prevention of cross-hauling of equipment.

During the past ten years or more, there has been a decided change in the attitude of shippers as to cars furnished for their lading. Demands are now made for first class cars, clean cars, etc., and in addition there is more and more demand for cars of some specific dimensions, either as to width, height, or length, single sheathed or double sheathed, wooden roof or metal roof, or completely wood lined, etc., which condition meets shippers' requirements. This naturally requires close co-operation between car department forces and operating and transportation department forces. When certain cars, such as "order cars" are required for connecting line or home line industrial lading, car forces should be given information by operating department forces (yardmaster or car order clerk), so proper inspection can be made and cars properly classified for such particular loading. This then protects each department, avoids dissatisfied shippers, unnecessary switching and expense.

Classification of Cars

In the classification of house cars, in order properly to take care of this work it should be done during daylight hours under blue flag protection. For some years, the matter of uniform inspection and reclassification has been a live subject. It does not seem that much progress has been made. It appears doubtful, but hopeful, if a real uniform inspection can be accomplished; the principal reasons are the views or peculiarities of the shippers in different sections of the country and the fast growing demands made by shippers for various types of equipment, difference of opinion by the shippers as well as car inspectors and car men. What may be an entirely acceptable flour car in the Twin City area may be unsatisfactory at Chicago, Buffalo or Kansas City. This same condition holds true of other classes of equipment. Some times it is difficult for an inspector on one railroad to commodity classify a car in a way that would be ac-

* Abstract of a paper presented by F. J. Swanson, general car department supervisor, Chicago, Milwaukee, St. Paul & Pacific, Minneapolis, before the regular monthly meeting of the Car Foremen's Association, of Chicago, held at the Hotel LaSalle, Chicago, September 13, 1937.

ceptable on another railroad, because of not knowing the peculiar local conditions at the loading point.

Flour cars, as we all know must be clean, free from protruding nails, bolt heads, have good floors and end and side walls, door posts, as well as door post nailers flush with side lining to prevent damage to contents. Cars must have good roofs and tight sides to prevent any damage due to water or cinders. Good judgment can be used in the classification of such cars.

Some times we feel that our job is quite difficult, but we must not become discouraged. We must feel that there is no problem in the railroad field that cannot be worked out to the satisfaction of all concerned; therefore, we should continue to strive toward adopting standards as far as practicable that would tend toward a more uniform inspection and re-classification.

On November 24, 1931, A.A.R. circular letter No. D. 11-348 was issued by the Transportation division of the A.A.R. which covers "Recommended Practice For Standard Inspection and a Uniform Inspection Card."

This recommended practice has been in effect for some six years, yet I doubt very much if the recommendation has had its effect. Most railroads employ their own classification or commodity cards, as well as instructions. The particular inspection card as shown on page 4 of circular letter D. 11-348, does not now comply with the A.A.R. Rule 36 Supplement Number 2, due to red printing. Furthermore, that card does not bring out the objective. If a car is found unfit for certain lading, this card cannot be used. The car must either be marked for the repair track or the cleaning track for reconditioning.

As station agents, where no car men are employed, are used and held responsible for loading out of their stations, they make their own inspections and re-classification. This card would not be practical if such cars were found requiring reconditioning. If the reverse side or back of these cards distinguished that such cars required reconditioning, the cars would go on through to the first repair or cleaning point for reconditioning, which makes for more prompt, proper and economical handling of equipment, eliminates considerable empty back-haul of equipment and gives the superintendent of transportation a true check of equipment as classified on the various divisions and side tracks.

The C. M. St. P. & P. is employing a system of inspection and application of commodity cars which I feel is very practical and efficient. We have a set of instructions covering inspection of cars for various lading, similar to circular D. 11-348, but our commodity cars are somewhat different. We employ the use of five cards, namely: (a) Car fit for loading flour, cereal, paper, sugar, and empty tin cans; (b) Car fit for loading bulk grain; (c) Car fit for loading cement; (d) Car fit for dressed lumber, sash and doors, furniture, hay, sheet steel, tin plate, canned goods, crated and boxed goods and general merchandise; and (e) Car fit for loading coal, hides, ties, oil, paint, grease, brick, tile, machinery, greased rods and shafting, scrap iron, scrap rags, scrap paper, rough lumber, tar, vinegar and similar rough freight commodities.

On the reverse side or back of cards bearing letters "A," "B," "C" and "D," we have added the letter "X" behind the letters mentioned. For illustration, if a flour car carded "A" is found unfit for flour loading, the "A" card which shows "AX" on reverse side, is applied, which signifies that this car is unfit for such loading until reconditioned. The transportation department sends this car to the nearest cleaning or repair tracks. In my opinion, the inspection or commodity card as shown in circular D. 11-348, could be improved upon for more economical handling of equipment and re-classification.

Sweating of Cars

Much has been said during the past few years as to interior sweating of cars, or condensation in box cars. A complete study was made by members of the A.A.R. Car Construction Committee, with the co-operation of Freight Claims division, Freight Containers bureau and the director of research of the Mechanical division. Four test house cars, steel sheathed, fully wood-lined, were assigned for this test and specially fitted up and equipped with observation windows, internal lighting, observation trap doors in side and end lining and roof lining used, as well as thermometers for temperature readings. The conclusion of this committee was that a special type of car is not established or justified. The proceedings of Division V, Mechanical Division, 1933 to 1935, inclusive, pages 139 to 142, inclusive, bring out the facts of the test.

Cleaning of Cars

For a good many years, all have been confronted with the question of cleaning house cars for higher class lading account floors, side and end walls being covered with oil and grease spots; also cars contaminated with a "green hide smell."

In the case of box cars, previously loaded with grease or oil commodities, if the floors and inside walls are thoroughly saturated, there is not much that can be done to recondition such cars for flour or other high-class lading. The top surface of oil can be removed by the use of steam and hot water and a solution of soda ash and lye, but there still remains some oil inside the wood which will syphon up when hot lading is loaded in the car. However, we have been quite successful on cars partly covered or spotted by using hot water sprayed under steam pressure and saturating oil spots with this soda ash solution.

The matter of box cars contaminated with green hide odors has been quite a problem for the past few years; however, some railroads are having success by use of spray washing and deodorizing operations. The material used is a solution known as "Freight Car Cleaner" which serves as a cleaner as well as a disinfectant. A certain amount is added to the hot water, which is thoroughly mixed and put on the car floor and inside walls of car. Two or three operations may be necessary to remove the hide odors as well as stains from car, making it possible to place the car in high-class loading.

In order to eliminate this unnecessary condition and expense, when cars are ordered for this class of lading, car forces, as well as station agent forces must make positive that rough freight cars or cars assigned for this lading be furnished. Continuous washing of inside walls and floors of house cars causes deterioration, increased freight car maintenance, shortens life of car, and causes empty mile hauling of equipment and switching expense, also delay to equipment. Much can be done to improve on these conditions.

Some railroads employ the use of floor sanders and planers for smoothing rough floors and lining which has been found practical, saving expense of removing rough lumber which would be necessary in order to use such cars for flour, paper and other high-class lading.

Wood-Patch is also being applied successfully to floors and inside walls of house cars. This material is applied similar to putty, dries hard, becomes a part of the object to which applied, does not shrink or expand, sheds water and stops all leakages; also, will not absorb odors. Appears to be very practical. Various floor sealers are also employed for covering over oil spots.

In conclusion I want to emphasize the important part the car man or supervisor plays who has charge and is responsible for classifying cars for commodity loading.

Naturally, the transportation department, as well as the operating department depends entirely on the commodity card which he has placed on the empty equipment, taking into consideration the necessity for making a positive inspection to the interior of car, with a view of developing whether it contains any protruding nails, spikes, bolts, rough floors and side walls, oil spots or other defects in the floor or siding liable to cause damage in the way of damage to its contents. It is also very important when applying this commodity card that the car itself is physically fit as far as the running gear, etc., is concerned, as delays mean quite an expense in freight claim payments.

During the year 1936 a total of approximately $21,000,000 was paid by the railroads for loss and damage. Claims due to train accidents increased 36.7 per cent. Those due to defective or unfit equipment 30.6 per cent. Those due to delay, 28.8 per cent.

Improper application of commodity cards when switched to an industry for loading some times after moving several hundred miles across country to get this particular loading, inspection discloses it is unfit for this particular commodity. This you appreciate causes a dissatisfied shipper, unnecessary cross haul of equipment and possible loss of business.

The proper selection of cars for commodity lading is highly essential. Conditions are changing so rapidly that car men must educate themselves to become acquainted and accustomed to the various classes of lading that cars are required to handle.

Informal Discussion Of Car Questions

In the November issue of the *Railway Mechanical Engineer* was published the informal discussion of car questions raised at the May meeting of the Northwest Carmen's Association. The discussions of some additional questions raised at this meeting are given below; they are not authoritative answers to the various points raised, but simply are the views of the association regarding a few of the many important questions which confront car men. Some questions, submitted in writing after the May meeting, were answered by the association's A.A.R. committee.

Question.—Occasionally cars are received from connecting lines with bad-order cards still attached. The only notation on the bad-order card is "Repack" or "Reweigh." One car, on which such cards were recently found, and removed, showed the car carded bad order and, opposite the word "Defect," "Repack" had been written in. The card was dated March 5, 1937, and the old repack date shown as November 7, 1935. Rule 66 provides for periodic repacking of journal boxes after the expiration of 15 months. As the date of the last repacking on the car referred to was not 16 months old, does it not appear that the repairing line was a little technical?

Answer.—The inspector was perfectly within his rights to card the car for repacking after the expiration of 15 months.

Question.—Effective April 1, 1937, cars defined as Class E-4, under Rule 112, will not be accepted from owners. In the event a Class E-4 car is offered in interchange, in otherwise good condition, what attitude should be taken by the receiving line?

Answer.—All roads in the Twin Cities have gone on record to the effect that such cars will not be accepted in interchange for line movement.

Question.—The Safety Appliance Laws require a minimum of 4 in. clearance on sides and back of handbrake wheels, and the A.A.R. Loading Rules require a minimum of 6 in. clearance at the same location. Why would it not be practical to adopt a clearance dimension that would be the same with both bodies.

Answer.—Safety Appliance Laws cover minimum requirements for safety; loading rules specify 6 in. in order to provide easier access for men to work.

Question.—To what extent is an originating carrier responsible for clearance for loads to destination, even though it acts as a switch line only?

Answer.—The originating line is responsible if it is the delivering line, even though it acts merely as a switching line.

Question.—Rule 107, Item 126 carries a labor charge of 0.2 hr. for removing and repairing coupler release levers, all types, one or two sections, whole or in part, including the pivot bolt in the Carmer type; exclusive of brackets or supports and their fastenings.

Rule 108, Item at top of page 216 excludes a charge for the connector between the handle section of the release lever and the knuckle lock lifter, J, S, Carmer, or similar types R. R. & R.

Does this prohibit a charge for the inside section of the Carmer lever where the same is removed, repaired and replaced?

Answer.—A charge is permissible.

Question.—Is sheathing split or broken behind a door on a refrigerator car a cardable defect?

Answer.—If merely caused by striking of door fixtures it would not be cardable, but if caused by any Rule 32 condition it would be cardable.

Question.—Do question and answer No. 9 or Rule 32 also apply to body bolsters?

Answer.—Yes.

Question.—Can anything be done on cars with AB brakes blowing through retainer besides cutting car out or changing triple?

Answer.—Blowing at the retaining valve when a car is equipped with AB brakes may be caused by one of several conditions.

In release position it may be caused by service slide-valve leakage, emergency slide-valve leakage, or ruptured diaphragm and timing-valve leakage.

In service and emergency position, it may be caused by service slide-valve leakage, release-insuring-valve leakage, or service-portion gasket leakage.

These defects can be distinguished only on a test rack.

The rules require that these valves (when found defective) should be sent to a repair point and no attempt made to repair them in the yard.

Question.—Rules 58 and 59, page 104. Can pipe and pipe fittings and connections be charged against owners on cars from which such items are missing as stated in these rules? A.A.R. Rules 58 and 59 give no information regarding charging of pipe and pipe fittings.

Answer.—A charge can be made against car owner. See Interpretation 2, Rule 58.

Question.—Rule 4, Sec. (b) reads: "Defect cards shall not be required for slight damage (new or old) which does not require repairs."

Why are defect cards being issued for damage that does not require repairs, such as sheathing on refrigerator cars that is raked only into the bottom of the bead? The cars remain in service year after year with the same old defects and are not repaired, and the de-

fect cards covering such defects become dirty and worn out and are not readable.

Answer.—Rule 4 specifies the extent of damage to be carded. Effort is being made to have this rule changed on refrigerator sheathing.

Question.—(a) What is the out-of-round wheel? (b) Is an out-of-round wheel necessarily worn through chill? (c) Is the gage used to condemn an out-of-round wheel the same that was formerly used to condemn worn through chill spots? (d) How is a worn through chill spot indentified?

Answer.—(a) A wheel out of round 1/16 in in a radius of 12 in., determined by gauge. (b) No. (c) Yes. (d) Wheel and Axle Manual recommends drawing a straight edge over the trend of wheel and if there is a pronounced bowing out at the rim the wheel is worn through chill.

Question.—Is a brake beam missing in fair usage a delivering line defect for which a defect card should be issued?

Answer.—Cars should not be offered in interchange with brake beam missing. No defect card should be issued.

Questions and Answers On the AB Brake

Operation of the Equipment (Continued)

222—*Q.—What change in the port connections are now made by the emergency slide valve?* A.—Connection is cut off between the emergency reservoir and the accelerated release piston chamber and established between the latter and the quick-action chamber.

223—*Q.—What is the effect of this connection?* A.—As the quick-action-chamber air is now acting on both faces of the accelerated release piston, putting it in balance, the 20 lb. differential causes the emergency piston to move to the extreme left, compressing the emergency piston return spring and moving the accelerated release piston to its extreme left-hand position.

224—*Q.—The emergency piston is now in what position?* A.—In accelerated release position.

225—*Q.—Up to this time has any movement of the service piston occurred?* A.—No.

226—*Q.—Why?* A.—Sufficient release differential has not been established across the face of the service piston to bring about any change.

227—*Q.—How is the emergency reservoir connected at this time?* A.—Movement of the emergency slide valve blanks the emergency reservoir port in the seat, bottling up this volume.

228—*Q.—How long does this condition exist?* A.—Until the service slide valve moves to release and connects the auxiliary- and emergency-reservoir pressures.

229—*Q.—In this position what communications are established in order to accelerate the release, and also the build up of the brake-pipe pressure?* A.—The brake cylinder is connected to the brake pipe via the inshot valve, passages to cavity *K* in the emergency slide valve, and passage leading to the accelerated emergency release checks.

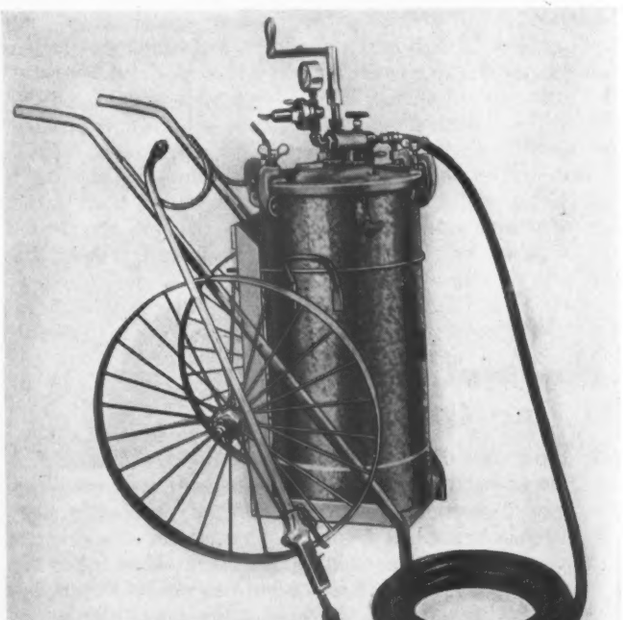
230—*Q.—Does this affect the auxiliary reservoir pressure?* A.—Yes. The brake cylinder and auxiliary reservoir are connected by the service slide valve and the pressure of these combined volumes is greater than that of the brake pipe.

231—*Q.—What results from this?* A.—The combined auxiliary and brake-cylinder pressures underneath the emergency release check valves, being greater than the pressure in the brake pipe above the check, cause the checks to unseat, permitting the air under the combined pressures to flow into the brake pipe.

232—*Q.—How long does this flow continue?* A.—Until the pressures are within about 10 lb. of equalization.

Portable Spray-Painting Equipment

The DeVilbiss Company, Toledo, Ohio, has recently developed and placed on the market a new spray-painting outfit especially designed for painting the rougher types of railroad equipment, such as box cars, gondolas, hoppers, tank cars, passenger car underframes and trucks, and baggage car interiors where application of a maximum volume of paint in a minimum amount of time is required.



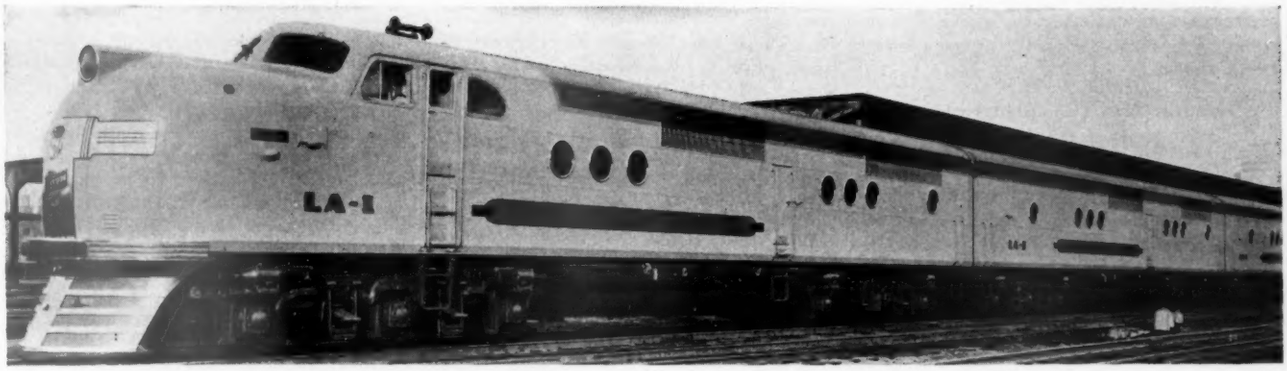
DeVilbiss Type QA-601 portable spray-painting outfit

The outfit consists of an extension gun, a 15-gal. tank, a 50-ft. length of ½-in. fluid hose and a two-wheel truck to provide easy portability. The spray gun is the single hose type, having an internal mix spray head. It is available with 3-ft. or 6-ft. extension.

The gun is furnished with two caps. No. 1 gives a fairly wide spray up to 16 in., while No. 2 delivers a narrower spray, 18 in., at somewhat greater velocity. Both caps will handle one quart of heavy box car paint per minute, producing a well atomized and even spray.

The mixing head atomizes the paint in the tank prior to its delivery to the gun where it is finally atomized by the spray head. The mixing head is equipped with air regulator, fluid shut-off valve, and adjusting valve.

The tank is equipped with a hand-operated agitator with which paint requiring agitation may be kept in proper state of suspension.



5,400-hp. Diesel locomotive recently delivered to the Union Pacific by the Electro-Motive Corporation

NEWS

C. & E. I. Coach Shop Destroyed by Fire

FIRE of undetermined origin completely destroyed the 125-ft. coach shop of the Chicago & Eastern Illinois at Danville, Ill., on November 22. The loss will total several hundred thousand dollars, since the building valued at $100,000 was completely destroyed, and machinery and tools and five coaches undergoing repairs were damaged.

Tank Car Head Block Anchorage Date Extended

IN a letter to all tank car owners, Secretary V. R. Hawthorne, A.A.R. Mechanical Division, calls attention to Interchange Rule 3, Sec. (t), Par. (8), in the 1937 Code, which provides that, effective January 1, 1938, tank cars having head block anchorage will be prohibited in interchange. Several requests for an extension of the above effective date were considered at a recent meeting of the Arbitration Committee, which approved a one-year extension in the effective date of this requirement, with the proviso that no further extension beyond January 1, 1939, will be granted. This action has been approved by the general committee.

A.A.R. Research on Axles

A COMPREHENSIVE program of research to determine what further improvements can be made in the methods of manufacturing axles used on locomotives and cars is being conducted by the Division of Engineering Research of the Association of American Railroads, according to a recent announcement from A.A.R. President J. J. Pelley. The tests, which began early in November, Mr. Pelley said, are designed to bring about "still greater safety and economy on the railroads of this country."

Steel axles, the statement points out, range from approximately 5½ in. in diameter, the size used on freight and passenger cars, to approximately 14 in., the size to which the massive driving wheels on modern locomotives are attached. The research work is being conducted on especially constructed testing machines which have been built at the Timken Roller Bearing Company plant at Canton, Ohio, and are under the direction of a committee of mechanical officers from the various railroads and axle manufacturers co-operating with L. W. Wallace, director of the Division of Engineering Research.

The first test deals with axles used on passenger cars, and when that has been completed a study of axles used on freight cars will be made. After that the test will include the various sizes of axles used on locomotives and locomotive tenders.

In order to test the strength and durability of the various sizes of axles, "gigantic" machines have been built at the Timken Roller Bearing plant which will rotate a full size axle at varying speeds while at the same time stresses will be placed on it at various locations to determine the number of revolutions that can be made before an axle actually breaks.

In order that complete knowledge can be obtained as to the various kinds of railroad axles now in use, several hundred axles of varying sizes are being put through every possible test. These axles have been obtained directly from the manufacturers and a complete detailed history of each one has been prepared from the time the ore was first received at the mill until the axle finally emerged from the

New Equipment Orders and Inquiries Announced Since the Closing of the October Issue

LOCOMOTIVE ORDERS

Company	No. of locos.	Type of loco.	Builder
C. B. & Q.	5		Company shops
Reading	2*	900-hp. Diesel switch.	American Locomotive Co.
	6*	600-hp. Diesel switch.	Electro-Motive Corp.

LOCOMOTIVE INQUIRIES

C. M. St. P. & P.	2†	Hiawatha	.....
	5†	4-6-4	.....
South Manchuria Railway	25-100	2-8-2	.....

FREIGHT-CAR ORDERS

Road	No. of cars	Type of car	Builder
Barrett Company	15	6,000-gal. Tank	Gen. Am. Tank Car Corp.
C. B. & Q.	600	Box	Company shops
	100	Hopper	
	400	Coal	
D. M. & I. R.	25	Ore	Pullman-Std. Car Mfg. Co.
L. C. L. Corp.	240	Air-activated containers	American Car & Foundry Co.
Northwestern Refrig. Line Co.	250	Refrigerator	American Car & Foundry Co.
St. Louis-San Francisco	6	70-ton Coal	American Car & Foundry Co.

FREIGHT-CAR INQUIRIES

D. L. & W.	500	50-ton Hopper	.....
Louisiana & Arkansas	100-300	Pulpwood	.....
U. S. Navy Dept.	1	50-ton Hopper	.....

PASSENGER-CAR ORDERS

Road	No. of cars	Type of car	Builder
C. B. & Q.	3‡	Dining	Edw. G. Budd Mfg. Co.
	5‡	Chair	
	3‡	40-seat Dinette	
New York Central	2§	Coaches	Edw. G. Budd Mfg. Co.

* To cost approximately $600,000.
† Prices sought preparatory to seeking authority of district court to secure additional motive power.
‡ To be of lightweight stainless steel construction—three dining cars and three chair cars for the "Aristocrat," two 40-seat dinette coaches for the Denver "Zephyr," one 40-seat dinette-coach for the original "Zephyr" and two chair cars to be used jointly by the Colorado & Southern and the Fort Worth & Denver City.
§ To be of lightweight construction.

steel mill as a properly rounded piece of steel 7½ ft. long and ready for the wheels to be attached.

Mechanical Division Letter Ballot Results

THE results of the 1937 letter ballot of the A.A.R. Mechanical Division have just been made available in circular No. DV-927, recently issued by the secretary's office. The recommendations for changes in the standard practice of the division, made by various committees at the June meeting at Atlantic City, N. J., were divided into a total of 113 propositions as follows: Arbitration Committee, 1 proposition; Brakes and Brake Equipment, 10 propositions; Car Construction, 6 propositions; Couplers with Draft Gears, 3 propositions; Air Conditioning and Equipment Lighting, 1 proposition; Locomotive Construction, 3 propositions; Specifications for Materials, 17 propositions; Tank Cars, 2 propositions; Wheels, 8 propositions; Loading Rules, 62 propositions.

As a result of a favorable letter ballot all of these propositions, from Nos. 1 to 113, inclusive, to amend the standard and recommended practice of the Division are approved. The propositions among the foregoing to amend the Interchange Rules and Loading Rules of the Division become effective January 1, 1938, with the exception of modifications already issued in Supplement No. 1 of the loading rules which became effective September 1, 1937. Propositions Nos. 13, 14 and 42, covering Definitions and Designating Letters, become effective immediately. All others become effective March 1, 1938.

Diesel Plan Book and Engine Catalog—A Correction

THE price of the Diesel Plan Book and Engine Catalog by John W. Anderson, described on page 533 of the November, 1937 issue of the *Railway Mechanical Engineer*, is incorrectly given as $2. The book costs $3.

Improvement Program

The Norfolk & Western's program of general improvements for the immediate future involves an expenditure of about $200,000 for shop tools, also the purchase of 4,000 sets of improved (AB) air brakes for application to freight cars.

The Western Pacific plans to ask for bids some time after January 1 for the work of constructing a new locomotive erecting and machine shop with two 125-ton locomotive lifting cranes and a new boiler plant at its general locomotive repair shops at Sacramento, Cal. This work will involve an expenditure of approximately $360,000.

The Atchison, Topeka & Santa Fe is engaged in enlarging its passenger engine and coach terminal at Chicago. As a part of this program, it has acquired approximately three acres of ground extending 240 ft. on Wentworth avenue and 560 ft. on Archer avenue. The facilities that will be constructed as a part of this enlargement program include a shop for servicing high-speed Diesel-electric engines and air-conditioning equipment, which will be 300 ft. long and 65 ft. wide; a two-story service building of approximately the same dimensions; and a single-story building 400 ft. by 30 ft. in plan. The latter two structures will accommodate such activities as carpet cleaning, the servicing of Pullman cars, painting, the repair of generators and batteries, and will contain storage facilities and locker rooms. The plans also contemplate the construction of a new power house, enlargement of the enginehouse and turntable, the construction of an enlarged yard for cleaning and servicing passenger equipment and the construction of additional storage tracks. A depressed pit 1,200 ft. long, for use in inspecting high speed trains, will also be constructed. Contracts have already been awarded for the grading for track changes, for the power house and for the enlargement of the enginehouse.

Riveted Aluminum Alloy Tank Cars

THE Interstate Commerce Commission, by Commissioner McManamy to whom the matter was assigned, has issued an order granting applications of the War Depart-

(*Continued on next left-hand page*)

* * *

One of the coaches of a glass train built at Doncaster, England

A train, almost completely of glass, except for the roof, has been built by Messrs. Pikkington Bros., Doncaster and is now touring England and Scotland. Blue mirrored Vitroflex—small squares of "unbreakable" glass—covers the coaches. Inside are glass floors, glass pictures, and a bathroom lined with Vitrolite and armored plate glass which bends without breaking. Two hundred varieties of glass are used in the train.

ment and the Gulf Oil Company, respectively, for authority to construct and operate in experimental rail service 25 and five tank cars with riveted aluminum alloy tanks for the transportation of gasoline. The order in No. 3666, In the Matter of Regulations for Transportation of Explosives and Other Dangerous Articles, points out that the applications were "unanimously recommended by the Tank Car Committee and concurred in by the Bureau of Explosives, Association of American Railroads."

The cars will be constructed in accordance with shipping container specification 103AL, which is embodied in the order, including A. A. R. requirements reproduced as an appendix to the specification.

Armco Dedicates Unique Laboratory

A NEW structure of novel design, which was built at Middletown, Ohio, to house the research laboratory of the American Rolling Mill Company, was dedicated on November 5 with more than 200 scientists from all parts of the country participating in the ceremony. At a banquet in the evening, which concluded the day's activities, the dedicatory address was made by Charles F. Kettering, vice-president in charge of research of the General Motors Corporation. Addresses were also presented by George M. Verity, chairman of the board of the Armco Rolling Mill Company, and by Charles R. Hook, president. Dr. Anson W. Hayes, Armco's director of research, was toastmaster.

The new single-story research building, which cost $280,000, embodies many products which were developed by the company's research organization. It represents the first use, on a large scale, of sheet metal in building construction. The building has a frontage of 250 ft. and a depth of 175 ft., providing 43,500 sq. ft. of floor space. It has a saw-tooth roof and the entire frame is of welded-steel construction with not a rivet driven in the structure.

Three of the exterior elevations are faced with combinations of porcelain-enameled iron sheets, stainless steel and glass block. The skeleton for the outside walls is formed of square metal tubing with similar tubing placed horizontally beneath the window sills and above the glass-block panels. All of the wall tubing is welded to the structural frame. In all sections, except at the glass-block openings, 20-gage galvanized panels, with flanges facing inward, are bolted to the framework and furnish the exterior wall covering. The interior walls of the laboratory section are covered with 22-gage flat-steel sheets painted in two tones of gray.

The rear wall, saw-tooth gables and most of the partitions in the laboratory section are of special insulated steel construction. The wall is formed with two thicknesses of light-gage sheet steel filled with a special mineral product similar to mica which possesses high sound-proofing and insulating qualities.

Ventilation and atmospheric conditions are controlled by two-air conditioning systems, one for the laboratory staff offices and one for the test shops and laboratory. Deep-well water is used for summer cooling.

There are 12 laboratories with complete facilities for specialized research. They include equipment for the testing of steel in process; welding methods with flat rolled materials; forged-steel car wheels; stainless steel; development of corrosion-resistant sheets and strip; iron strips for porcelain enameling; high-finished sheets for deep drawing; sheets for electrical uses; development of zinc and other metal coatings for sheets; development of non-metallic coatings and the improvement of surfaces to hold these coatings; blast-furnace, open-hearth and electric-furnace experiments.

Porcelain enamel, stainless steel and glass block form the exterior of the new research laboratories of The American Rolling Mill Company, Middletown, Ohio

Arch Bar Date Extended

IN a letter to all car owners signed by J. M. Symes, vice-president, A.A.R. Operations and Maintenance Department, attention is called to an extension of the date when cars with arch-bar trucks will not be accepted in interchange from car owners. The Board of Directors of the association considered this matter and a number of applications for extension of its effective date at a meeting held at Chicago on Thursday, November 18, 1937. The board has directed that the effective date of this rule be extended until July 1, 1938; with the further provision that, after April 1, 1938, mileage or per diem shall not be paid car owners for cars equipped with arch bar trucks.

Supply Trade Notes

CARY D. TERRELL, vice-president of the American Car and Foundry Company, with headquarters at Chicago, will resign on January 1, because of ill health.

J. H. VAN MOSS has been appointed western sales manager of the American Car and Foundry Company, with headquarters at Chicago, and W. P. McBride will be assistant western sales manager.

SAMUEL F. PRYOR, JR., has been appointed assistant to the president of the American Brake Shoe & Foundry Company. Mr. Pryor is also vice-president of the Southern Wheel Division of the company, with headquarters at New York.

FRANK FISHER has been appointed western manager of The Pilliod Company, with headquarters at Chicago.

THE RAILWAY TRUCK CORPORATION, 80 E. Jackson boulevard, Chicago, has been organized to manufacture and sell bolster friction springs and truck stabilizing devices for freight cars. Officers and incorporators of the new company are W. W. Rosser, president; J. F. Ryan, vice-president; and A. C. Davidson, chief engineer.

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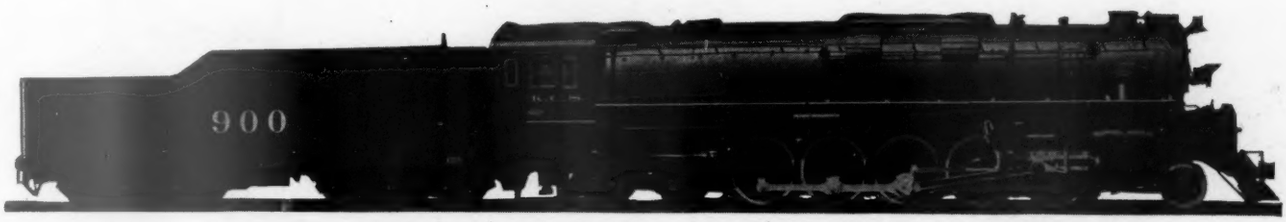
HEAVY POWER

FOR FAST FREIGHT SERVICE



LIMA BUILT POWER FOR THE KANSAS CITY SOUTHERN

These ten 2-10-4 type freight locomotives are representative of modern motive power embodying high capacity and speed with economical operation. » » » »

WEIGHTS IN WORKING ORDER, POUNDS				
On Drivers	Eng. Truck	Trailer Truck	Total Engine	Tender Loaded
350,000	50,600	Front 53,200 Rear 55,200	509,000	348,000

WHEEL BASE			TRACTIVE EFFORT
Driving	Engine	Eng. & Tender	93,300
24′ 4″	48′ 8″	98′ 5″	

BOILER		CYLINDERS		DRIVING WHEEL
Diameter	Pressure	Diameter	Stroke	Diameter
92″	310 lb.	27″	34″	70″

LIMA LOCOMOTIVE WORKS LIMA LOCOMOTIVE WORKS INCORPORATED INCORPORATED, LIMA, OHIO

L. W. WALLACE, director of engineering research of the Association of American Railroads, has resigned to become director of engineering and research of the Crane Company, Chicago. This newly created division of the Crane Company comprises the existing division of research and development and the product engineering department and has been formed to coordinate all engineering activities and further progress in diversified fields. Mr. Wallace will be directly responsible to the president and under his supervision the

L. W. Wallace

division will conduct the necessary research and engineering to develop present and new products. A sketch of Mr. Wallace's career appeared in the September *Railway Mechanical Engineer,* page 423.

United States Steel Corp. Appointments

BENJAMIN F. FAIRLESS, president of the Carnegie-Illinois Steel Corporation, has been elected to succeed William A. Irvin as president of the United States Steel Corporation as of January 1, 1938, Mr. Irvin being elected vice-chairman of the board, effective January 1. Myron C. Taylor confirmed to the board his intention, as previously stated to them, not to accept re-election as chairman of the board of directors at the time of its annual meeting, April 4, 1938. Mr. Taylor will thereafter maintain his present office at 71 Broadway, New York, and will continue as a member of the board and of the finance committee. It is planned that Edward R. Stettinius, Jr., present chairman of the finance committee, shall succeed Mr. Taylor as chairman of the board on April 5 next; and that Enders M. Voorhees, now vice-chairman of the finance committee, shall then assume the chairmanship of that committee. J. L. Perry, now president of the Tennessee Coal, Iron & Railroad Co., will, on January 1, 1938, succeed Mr. Fairless as president of the Carnegie-Illinois Steel Corporation, and Robert Gregg, vice-president of the United States Steel Corporation, will become president of the Tennessee Coal, Iron & Railroad Co., as of January 1. The resignation of Thomas Morrison of Pittsburgh as a director of the corporation was accepted and Mr. Fairless was elected to fill the vacancy.

Benjamin F. Fairless, who was born at Pigeon Run, Ohio, on May 3, 1890, is a graduate in civil engineering of Ohio Northern University which, a few years ago conferred upon him the honorary degree of doctor of engineering. For two

(c) Bachrach

B. F. Fairless

years Mr. Fairless was a teacher and, for a few months, a civil engineer for the Wheeling & Lake Erie. In August, 1913, he became a civil engineer for the Central Steel Company of Massillon, later becoming, in turn, mill superintendent, general superintendent, and vice-president in charge of operations. When the United Alloy Steel Corporation and Central merged in September, 1926, Mr. Fairless was appointed vice-president and general manager of the United Alloy Steel, and in April, 1928, became president and general manager of the company. When this company, in April, 1930, was one of several united in the formation of the Republic Steel Corporation, Mr. Fairless went into the new organization as executive vice-president. When the newly created Carnegie-Illinois Steel Corporation was formed in the autumn of 1935 from the Carnegie Steel Company and the Illinois Steel Company, both units of the United States Steel community of companies, Mr. Fairless was made president.

J. L. Perry was born at Worcester, Mass., on March 11, 1881, and was educated in the grade and high schools of

J. L. Perry

Worcester. He began his business career with the American Steel & Wire Co., in its Worcester plant in 1899, and after occupying various positions became manager of the Worcester district of this company in 1928. On January 1, 1933, he was elected to the vice-presidency of the American Steel & Wire Co., in charge of operations, with headquarters at Cleveland, Ohio, and in February, 1935, was elected president of the Tennessee Coal, Iron & Railroad Co., of Birmingham, Alabama.

Robert Gregg, formerly president of the Tennessee Coal, Iron & Railroad Co., was appointed vice-president in charge of sales of the United States Steel Corporation on February 1, 1935. Mr. Gregg is 52 years of age and a native of Atlanta, Ga. He

Blank & Stoller

Robert Gregg

was educated in the Atlanta public schools, Georgia School of Technology, and was graduated from Cornell University. He began his business career in August, 1907, with the Atlanta Steel Company of Georgia, continuing with that company and its successor, the Atlanta Steel Company, until August 1, 1932. He then resigned to accept the vice-presidency of the Tennessee Coal, Iron & Railroad Co., and in October, 1933, became president of that company.

Simmons-Boardman Elects Two Vice-Presidents

ROBERT E. THAYER and H. A. MORRISON of the Simmons-Boardman Publishing Corporation have been elected vice-presidents of the corporation. Mr. Thayer is New England manager of the Railway Age and business manager of the *Railway Mechanical Engineer,* with headquarters at New York, and Mr. Morrison is western manager of Railway Age and business manager of Railway Signaling at Chicago.

Robert E. Thayer was born at Chelsea, Mass., on August 4, 1883. He is a graduate of the Massachusetts Institute of Technology, from which he obtained the degree of Bachelor of Science in Mechanical Engineering in 1907. Immediately upon leaving the Institute he accepted a position with the American Locomotive Company as a special apprentice. In 1908 he became an instructor in mechanical engineering at his Alma Mater, M.I.T. During 1910 he served as a draftsman in the mechanical department of the Boston & Maine at Bos-

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ton, Mass. During the following year he entered the service of the Simmons-Boardman Publishing Corporation, becoming an associate editor on the staff of the Railway Age Gazette (now the Railway Age). In

R. E. Thayer

January, 1917, he became mechanical department editor of the Railway Age and, at the same time, managing editor of the *Railway Mechanical Engineer*. In 1919 he was appointed European editor of the Railway Age and associated Simmons-Boardman publications, with headquarters at London, England. Early in 1922 he returned to the United States as New England advertising manager of all Simmons-Boardman transportation publications and, in June, 1929, became also business manager of the *Railway Mechanical Engineer* and, later, business manager of the Car Builders' and Locomotive Cyclopedias. He continues to retain these responsibilities in his capacity as vice-president. Mr. Thayer has been a member of the American Society of Mechanical Engineers since 1919.

H. A. Morrison was born on December 21, 1892, at Indianapolis, Ind., and studied electrical engineering at Purdue University. In 1912 he entered the traffic department of the Pennsylvania at Indianapolis, where he remained until 1915, when he became a special apprentice in the electrical department of the Chicago, Rock Island & Pacific at Silvis, Ill. In June, 1918, he was transferred to the office of the general mechanical superintendent at Chicago. On September 1, 1919, he resigned to become sales engineer of the United States Light & Heat Corp., Chicago, becoming district manager of the railway sales department on May 1, 1924. On May 1, 1925, Mr. Morrison resigned to enter the service of the Simmons-Boardman Publishing Corporation as sales representative at Chicago. On July 1, 1930, he was appointed business manager of Railway Signaling, a Simmons-Boardman publication, and on August 2, 1932, became western manager in charge of sales in the western

H. A. Morrison

territory for all transportation publications of the company, at the same time continuing as business manager of Railway Signaling. In the capacity of vice-president, Mr. Morrison will retain the responsibilities of both these positions.

Obituary

FREDERICK W. BRILL, for many years assistant treasurer of the J. G. Brill Company, Philadelphia, Pa., died in the Jefferson hospital, Philadelphia, on October 23. Starting in 1896, in the engineering department, Mr. Brill was transferred to the sales department in 1906, making his headquarters at St. Louis, Mo.

HOMER D. WILLIAMS, former president of the Carnegie Steel Company and later of the Pittsburgh Steel Company, died on November 13, in the University of Maryland Hospital, Baltimore, Md., at the age of 74 years. Mr. Williams had served 56 years in the steel industry at the time of his retirement in February, 1936.

JAMES B. ARMSTRONG, secretary and treasurer of the Flannery Bolt Company, Bridgeville, Pa., died on November 6, following an emergency operation for appendicitis. For a number of years, Mr. Armstrong was associated with the Crucible Steel Company of America and the Brown Iron Company before his association with the Flannery Bolt Company.

CHARLES C. CLUFF, who retired in 1932, after serving as New York sales manager of the Carnegie Steel Company, the Illinois Steel Company and the Tennessee Coal, Iron & Railroad Company, died on November 13, at his home in New York, at the age of 74 years. Mr. Cluff had been in the steel industry for about 50 years, until his retirement in 1932. He was the last of the three original incorporators of the United States Steel Corporation.

CLARENCE M. BURNETT, vice-president of the Lewis Bolt & Nut Co., Minneapolis, Minn., and one of the founders of the company, died at his home in St. Paul on October 31. Mr. Burnett was born on December 31, 1883, at Chippewa Falls, Wis. After attending public schools at Bethel, Vt., he was graduated from Norwich College, Northfield, Vt. Mr. Burnett was for many years in the steel business at Bethlehem, Pa. Shortly before the World War he went to Minneapolis, where he was connected with the Twin City Forge & Foundry Co. After serving eight years as sales manager for Paper Calmenson & Co., he aided in the formation of the Lewis Bolt & Nut Co.

Personal Mention

General

F. B. BARCLAY, superintendent of motive power of the Illinois Central at Chicago, has retired.

J. F. JENNINGS, superintendent of equipment of the Michigan Central, with headquarters at Detroit, Mich., has had his jurisdiction extended to include the West division of the M.C.

JOSEPH CHIDLEY, superintendent of equipment of the New York Central, West of Buffalo, and the Ohio Central Lines, with headquarters at Cleveland, Ohio, has had his jurisdiction extended to include the Western division of the N.Y.C.

E. M. WILCOX, superintendent of equipment for the New York Central System, at Chicago, has been appointed assistant superintendent of equipment with the same headquarters, and the position of superintendent of equipment has been abolished.

A. B. CHILDS has been appointed acting mechanical engineer of the Northern Pacific, with headquarters at St. Paul, Minn., to succeed G. F. Endicott, who has been granted a leave of absence.

F. S. ROBBINS, superintendent motive power of the Atlantic Coast Line, has been appointed general superintendent motive power, with headquarters as before at Wilmington, N. C., succeeding James Paul, who retired on November 1. A photograph of Mr. Robbins and a biographical sketch of his railway career were published in the November issue of the *Railway Mechanical Engineer*, in connection with his appointment as superintendent motive power.

G. C. CHRISTY, superintendent of the car department of the Illinois Central at Chicago, has been appointed superintendent of motive power, succeeding F. B. Barclay.

WILLARD J. DANN has been appointed mechanical inspector of the Chicago, Burlington & Quincy, with headquarters at Chicago, to succeed Louis G. Kunzer, who has retired from active service after having been in the employ of this company 40 years.

(*Turn to next left-hand page*)

NO. 9 OF A SERIES OF FAMOUS ARCHES OF THE WORLD

HOPEWELL ROCKS

PETITCODIAC RIVER, NEW BRUNSWICK

Tides of the Bay of Fundy, between New Brunswick and Nova Scotia, do strange things to the Canadian landscape—much to the delight of the tourists. For one thing, they rush up the Petitcodiac River with tremendous force and create the famous Bore . . . A wall of water from three to six feet high (it depends on the season) drives along until it reaches the bend in the river opposite Moncton. There the two-direction river is half a mile wide and the incoming flood makes a waterway capable of floating large vessels . . . Fundy tides create the Hopewell Rocks, too, with their strange shapes and their many high arches. Erosion is one of the most fantastic of sculptors . . . The Rocks are at Hopewell Cape, about twenty miles from the city of Moncton, N. B. . . . Moncton, the transportation centre of Canada's Maritime Provinces, is headquarters of the Atlantic Region of the Canadian National Railways.

* * *

The Security Sectional Arch for the locomotive firebox improves fuel economy on any locomotive. It has had a major influence in firebox design of large modern power and is essential to their successful operation.

JOSEPH A. DEPPE, assistant superintendent of the car department, has been appointed superintendent of the car department, with headquarters also as before at Milwaukee, to succeed K. F. Nystrom.

KARL F. NYSTROM, superintendent of the car department of the Chicago, Milwaukee, St. Paul & Pacific, has been appointed mechanical assistant to the chief operating officer, with headquarters as before at Milwaukee, Wis.

OTTO JABELMANN, assistant general superintendent of motive power and machinery of the Union Pacific, with headquarters at Omaha, Neb., has been appointed to the newly-created position of assistant to the president in charge of research.

LEE ROBINSON, assistant to the general superintendent of motive power of the Illinois Central at Chicago, has been appointed superintendent of equipment, following a change in the title of F. R. Mays from general superintendent of motive power to general superintendent of equipment.

Master Mechanics and Road Foremen

J. H. PAINTER, master mechanic of the Atlantic Coast Line at Florence, S. C., has retired.

HOWARD P. PERRY has been appointed master mechanic of the Lehigh & Hudson River, succeeding Fred Jackson, deceased.

K. A. CRAIG has been appointed traveling locomotive inspector of the Kansas City Southern, with headquarters at Pittsburgh, Kan. Mr. Craig's jurisdiction will extend over the entire line.

R. J. MACNAMARA, assistant trainmaster of the Monongahela division of the Pennsylvania, with headquarters at Pittsburgh, Pa., has been appointed acting road foreman of engines of the Wilkes-Barre division, with headquarters at Sunbury, Pa.

GEORGE B. ECKER, road foreman of engines, in charge of the entire Cincinnati Terminal of the Baltimore & Ohio, with headquarters at Cincinnati, Ohio, has been appointed road foreman of engines, with headquarters at Washington, D. C.

W. J. WISENBAUGH has been appointed road foreman of engines of the Cincinnati sub-division of the Ohio division, and Louisville sub-division of the St. Louis division of the Baltimore & Ohio, with headquarters at Cincinnati, Ohio.

V. N. STAHLEY, road foreman of engines of the Chicago Great Western, has been appointed general road foreman of engines with headquarters at Oelwein, Iowa, to succeed T. Olson, who was appointed master mechanic several months ago.

OSCAR G. PIERSON, general foreman of the Atchison, Topeka & Santa Fe, at Arkansas City, Kan., has been promoted to the position of master mechanic of the Oklahoma and Southern Kansas divisions, with headquarters at Arkansas City, to succeed John K. Nimmo, retired.

W. G. WILSON has been appointed master mechanic of the Illinois and Missouri divisions and the DuPo terminals of the St. Louis Terminal division of the Missouri-Pacific and of the Missouri-Illinois Railroad (a subsidiary of the Missouri Pacific), with headquarters at DuPo, Ill., to succeed W. C. Smith, who has retired.

CHARLES D. SMITH, who has been appointed master mechanic of the Port Arthur Division of the Canadian National, with headquarters at Sioux Lookout, Ont., as noted in the November issue of the *Railway Mechanical Engineer*, was born on February 23, 1888, at Creemore, Ont. He attended public and high schools and entered the service of the Canadian Pacific in October, 1904, as a machinist apprentice at North Bay, Ont. From May, 1906, until May, 1907, he was a fireman on the Temiskaming & Northern Ontario at North Bay. He then became a fireman on the Canadian National, and in March, 1908, an engineman. He was in passenger service on the Canadian National out of Edmonton, Alta., from 1911 until his appointment as master mechanic at Sioux Lookout.

Purchasing and Stores

E. A. RUSSELL, district storekeeper of the Canadian National at Saskatoon, Sask., has been transferred to Edmonton, Alta.

J. B. FRASER, storekeeper of the Canadian National at Point St. Charles, Montreal, has been appointed district storekeeper at Saskatoon, Sask.

C. S. ARGYLE, district storekeeper of the Canadian National at Transcona, Man., has been appointed assistant general storekeeper at Winnipeg, Man.

W. C. HOWARD, chief clerk of the Canadian National at Montreal, has been appointed storekeeper at Point St. Charles, succeeding J. B. Fraser.

W. L. OSWALT, assistant works storekeeper of the Pennsylvania, with headquarters at Altoona, Pa., has been appointed works storekeeper, succeeding O. V. Daniels, deceased.

J. C. MCCAUGHAN, general foreman of stores of the Chesapeake & Ohio, at Huntington, W. Va., has been appointed district storekeeper, with headquarters at Richmond, Va.

B. A. CUMBEA, division storekeeper of the Chesapeake & Ohio at Clifton Forge, Va., has been appointed general foreman of stores at Huntington, W. Va.

C. S. JONES, district material supervisor of the Southern Pacific at West Oakland, Calif., has been appointed division storekeeper, with headquarters at Portland, Ore., to succeed J. F. McAuley, deceased.

S. A. HAYDEN, general storekeeper of the Missouri-Kansas-Texas, with headquarters at Parsons, Kan., has been promoted to assistant purchasing agent and general storekeeper, with headquarters at St. Louis, Mo.

J. B. NOYES, general storekeeper of the Minneapolis, St. Paul & Sault Ste. Marie, has been appointed assistant purchasing agent and general storekeeper, with offices at Shoreham (Minneapolis), Minn.

G. W. LEIGH, purchasing agent of the Minneapolis, St. Paul & Sault Ste. Marie, the Duluth, South Shore & Atlantic and the Mineral Range, has been appointed purchasing agent and general storekeeper of these roads, with offices at Shoreham (Minneapolis), Minn.

Car Department

J. F. MONGER, general foreman of the car department of the Illinois Central at Chicago, has been appointed car shop superintendent at Chicago, succeeding J. M. Brophy.

J. M. BROPHY, car shop superintendent of the Illinois Central at Chicago, has been appointed superintendent of the car department, with headquarters at Chicago. Mr. Brophy has been in the service of this company for more than 24 years. During the early years of this period he served as a car-repair inspector, air-brake inspector and assistant foreman at Ft. Dodge, Iowa,

J. M. Brophy

and Waterloo. In June, 1916, he was transferred to Paducah, Ky. From August, 1917, to March, 1919, he was in the service of the United States Army, returning to the Illinois Central after the war as an inspector, serving at Paducah and Owensboro, Ky. In May, 1921, Mr. Brophy was appointed coach foreman at Louisville, Ky., and in December, 1928, became general car foreman at the same point. After a year in the latter capacity he was assigned to a similar position at the Burnside shops, Chicago, where he served until March, 1934, when he was appointed car shop superintendent.

Shop and Enginehouse

J. MCALLISTER, supervisor shop machinery and tools of the New York Central at West Albany, N. Y., has retired.

Obituary

J. J. MAGINN, superintendent of motive power of the New York, Chicago & St. Louis, with headquarters at Cleveland, Ohio, died on November 13.

VOL. 111 No. 12

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CANTON RAILROAD
20
Economical
E·M
The same Diesel Engine that is performing so reliably in the high speed streamlined trains is used in GM Diesel Switchers.

To Operate
To Maintain
To Service

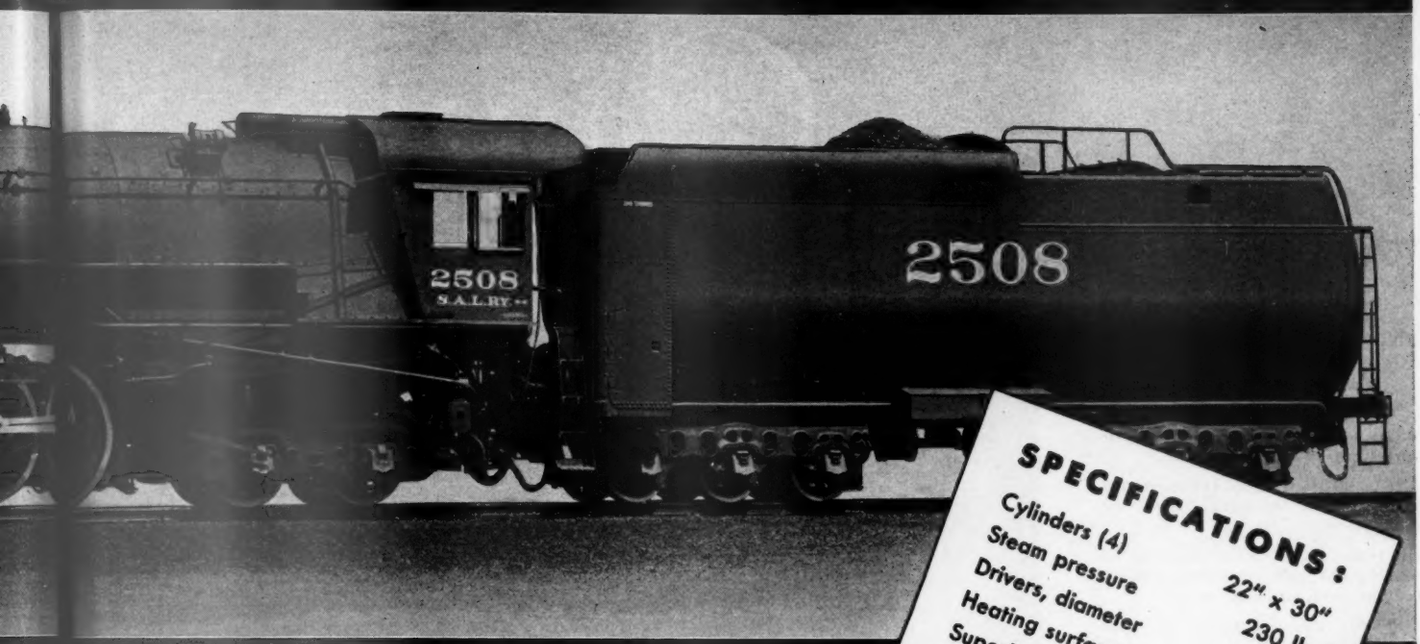
ECONOMICAL TO OPERATE—GM 600 H.P. 100-ton Diesel Switchers are operating at an hourly fuel cost as low as 18 cents — approximately 80 per cent less than for a comparable steam engine.

ECONOMICAL TO MAINTAIN—The Diesel Engine—the heart of the power plant — is especially designed for railway service. Individual injection units for each cylinder, uniflow 2-cycle with scavenging blower, a reliable pressure lubrication system — all of which contribute to dependable and economical performance. Furthermore, engine compactness permits maximum accessibility and simplifies inspections and running repairs.

ECONOMICAL TO SERVICE—GM Diesel Switchers frequently operate an entire week without refueling. Sanding is generally done during daily inspection. There is no expense or loss of engine-hours for taking water, ash pit cleaning or boiler washing.

ELECTRO-MOTIVE CORPORATION
SUBSIDIARY OF GENERAL MOTORS
LA GRANGE, ILLINOIS, U.S.A.

GETS REPEAT ORDER



RAILWAY

SPECIFICATIONS:

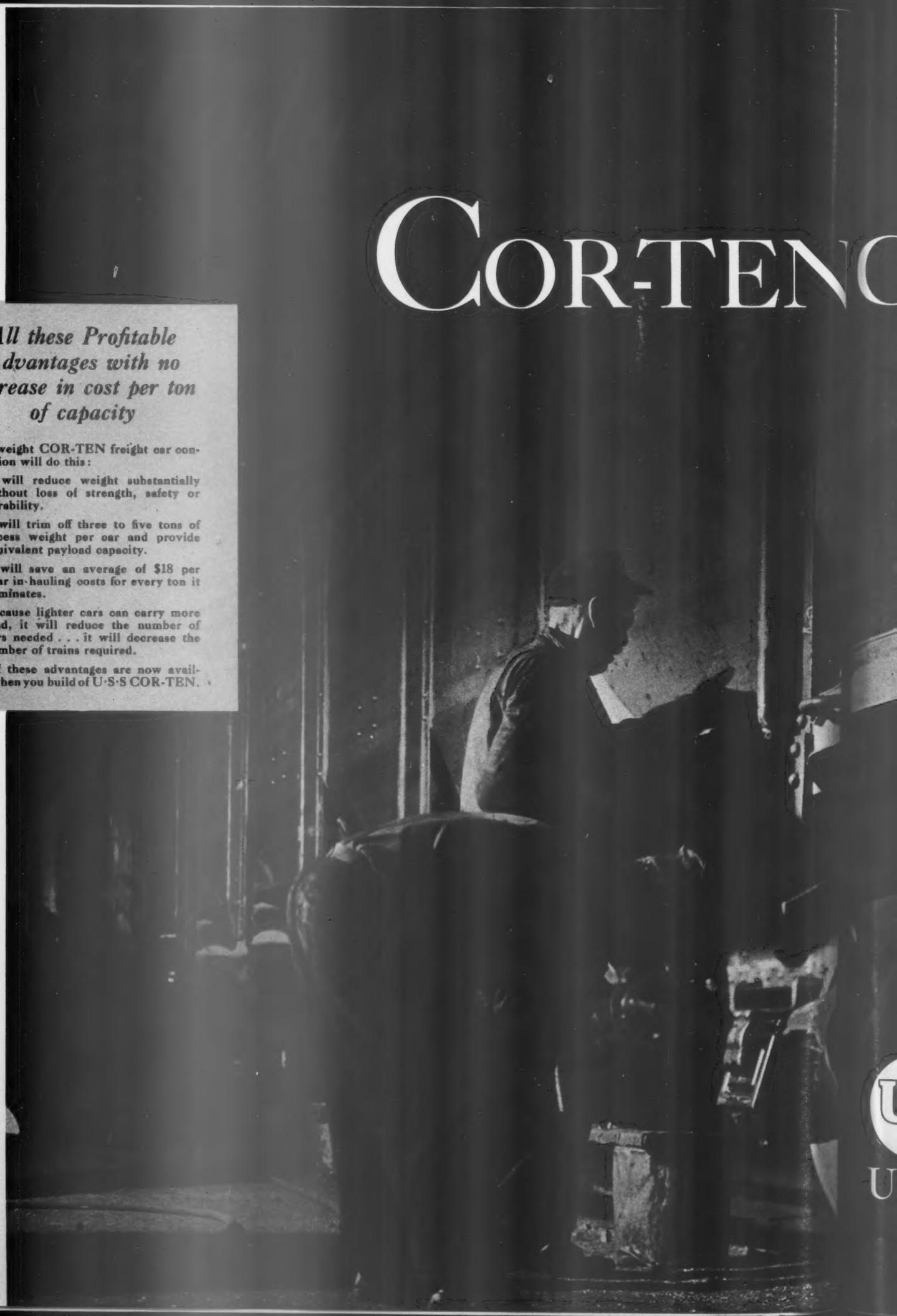
Cylinders (4)	22" x 30"
Steam pressure	230 lb.
Drivers, diameter	69"
Heating surface	5429 sq. ft.
Superheating surface	2397 sq. ft.
Weight on drivers	330,000 lb.
Weight, total eng.	480,000 lb.
Weight, engine and tender	793,800 lb.
Tractive force	82,300 lb.

For more than two years, the first five locomotives, class R-1, have been operating in regular scheduled freight service on the 254-mile run between Richmond and Hamlet. They have also been used successfully to handle heavy passenger trains at high speed.

The proof of their efficiency lies in the repeat order for five locomotives, class R-2, which are practically duplicates. These are now going into the same service.

It takes Modern Locomotives to make money these days!

WORKS • • • PHILADELPHIA



All these Profitable Advantages with no increase in cost per ton of capacity

Lightweight COR-TEN freight car construction will do this:

It will reduce weight substantially without loss of strength, safety or durability.

It will trim off three to five tons of excess weight per car and provide equivalent payload capacity.

It will save an average of $18 per year in hauling costs for every ton it eliminates.

Because lighter cars can carry more load, it will reduce the number of cars needed . . . it will decrease the number of trains required.

All of these advantages are now available when you build of U·S·S COR-TEN.

NCONSTRUCTION *costs no More*

ORIGINALLY the price of U·S·S COR-TEN was *twice* that of plain copper steel. Despite this, 23 railroads applied COR-TEN in over 10,000 cars. They figured that even at the higher initial cost, lightweight freight equipment would prove its ultimate economy.

But there were skeptics, too. Yet even the most skeptical agreed that substantial savings would be effected when such lightweight equipment could be built without adding to construction costs. That time has now arrived.

Now, a car of lightweight COR-TEN equipment costs little more than similar construction of plain copper steel and, when the comparison is based on cost per ton of capacity, the COR-TEN equipment is sometimes even less expensive.

If you wish a study made of your equipment designs, make your desires known to the nearest district sales office of a subsidiary company, or to the Railroad Research Bureau, United States Steel Corporation Subsidiaries, Frick Building, Pittsburgh, Pa.

U·S·S HIGH TENSILE STEELS

AMERICAN STEEL & WIRE COMPANY, *Cleveland, Chicago and New York*
CARNEGIE-ILLINOIS STEEL CORPORATION, *Pittsburgh and Chicago*
COLUMBIA STEEL COMPANY, *San Francisco*
NATIONAL TUBE COMPANY, *Pittsburgh*
TENNESSEE COAL, IRON & RAILROAD COMPANY, *Birmingham*
UNITED STATES STEEL PRODUCTS COMPANY, *New York*, Export Distributors

USS

UNITED STATES STEEL

Aggressive Maine Railroad LEADS THE WAY *in Railway Air Conditioning!*

S. M. ANDERSON, STURTEVANT RESEARCH ENGINEER GIVES FIRST HAND ACCOUNT OF SYSTEM AND RESULTS

ULTRA-VIOLET RAY sterilization—"shockless" cool air—complete elimination of odors—stability of control—a few of many features on Bangor and Aroostook "Flyer"!

"I AM GOING to try to tell you, in my own words, of an epoch-making event in railway air conditioning. It happened on August 15, 1937. And it concerns a small but far-sighted and aggressive railroad... the Bangor and Aroostook, operating between Bangor and Van Buren, Maine.

"On this memorable day in August, the luxurious 'Aroostook Flyer' was christened and made its first exhibition run. I say *memorable,* for this new train not only contained the most modern of railway air conditioning systems available but incorporated, in addition, ultra-violet ray equipment for sterilizing the air as a protection against bacteria and other micro-organisms expelled by passengers.

"The Aroostook Flyer consists of five cars, all air conditioned. There are two coaches and three combination coach and buffet cars. All cars are equipped with Sturtevant 'Railvane' Spray Type Air Conditioning Units, which represent a distinct advance over the conventional designs in other cars in service today. Ice is the source of refrigeration.

"This system: (1) Cools, dehumidifies, filters, washes, sterilizes, and distributes the air—in the summertime; (2) Heats, filters, sterilizes and distributes the air—in the wintertime.

"I have traveled on this train a number of times and have carefully observed conditions within the cars under a wide variety of passenger loads and outside weather conditions. I have returned from these trips enthusiastic about the performance of the system, and the officials of the railroad are just as enthusiastic as I am.

"At all times the air in the cars had a fresh, pleasing, *mellow* quality that evoked the praise of passengers. There is no sensation of *sharp-cold* and *shock* on entering a car from the hot, humid outside atmosphere.

"There is complete absence of odors and staleness in the air. This will be true in the wintertime, too, *for main cooling coils are entirely omitted.*

"The ability of the spray system to act as a stabilizing influence on temperature and humidity, and the stability of control which the spray units make possible, are among other very important advantages.

"The purpose of the ultra-violet ray is to free the air of the car from the objectionable micro-organisms expelled by the passengers. The ultra-violet sterilizer is located directly over the re-circulated air intake grille, and its effect is to disinfect the conditioned air. The ultimate hygienic effect, therefore, is the same as would be accomplished by replacing the recirculated air in the car with substantially the same volume of outside air.

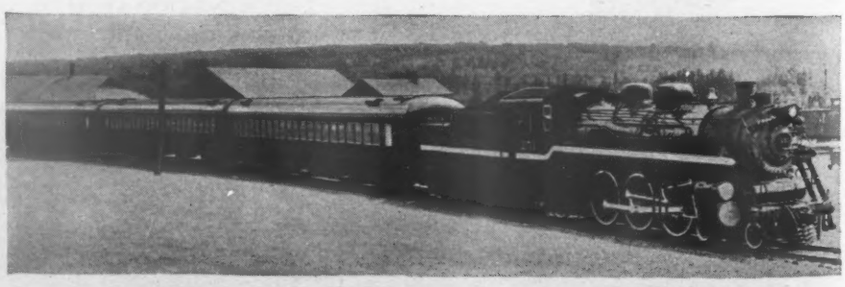
"This ultra-violet ray equipment is operated only during the wintertime. During the summer, when the sprays are used, the washer exerts a similar effect. When the air is thoroughly washed in a deluge of *highly atomized* water in the spray chambers, it is freed from bacteria in much the same manner that rain frees outdoor air from pollens or other particles.

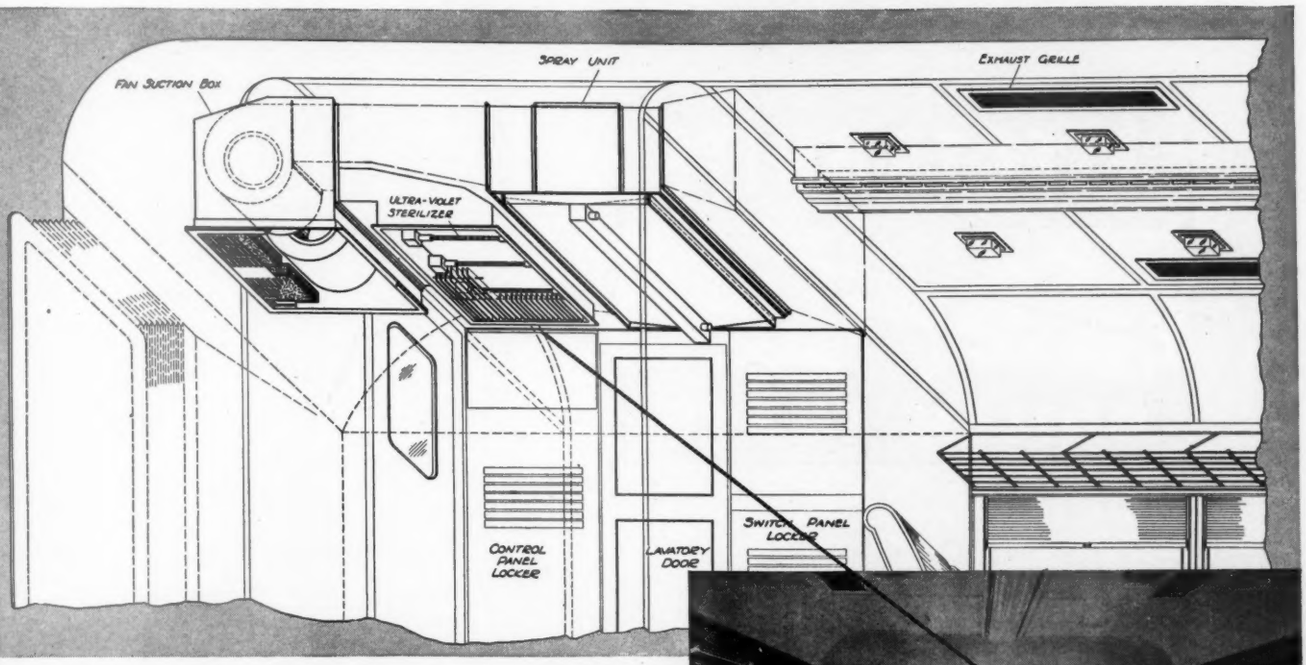
"The air purification design was developed last year with the aid of the consulting services of W. F. Wells and M. W. Wells of the University of Pennsylvania. It applies the hygienic principles established by their fundamental researches to the air conditioning technique developed by the B. F. Sturtevant Co.

"It is my prediction, as well as the belief of my company, that this spray type air conditioning system with ultra-violet ray sterilization, will receive the endorsement of railroads everywhere."

S. M. Anderson

Research Engineer
B. F. STURTEVANT CO.

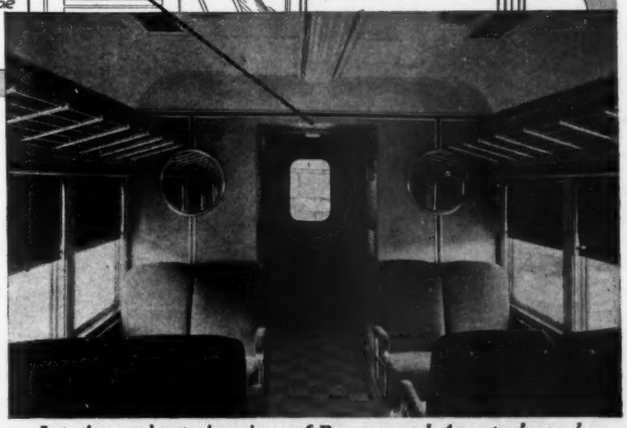




ADVANTAGES OF STURTEVANT SPRAY TYPE UNITS WITH ULTRA-VIOLET RAY

When Sturtevant "Railvane" Spray Type Units are used in connection with ice, Freon, or steam jet systems, all the advantages of standard air conditioning are made available—plus the additional advantages of:

1. Mellowed air—no sensation of *sharp-cold* and *shock* to passengers.
2. Elimination of dust and odors from air in the summertime, by washing.
3. No odors in the wintertime from offensive accumulations on cooling surface, since main cooling coils are entirely omitted.
4. If desired, the spray units can be used in mild or hot, dry, dusty weather as Evaporative Coolers—to freshen and cool the car with 100% washed outside air without the use of refrigeration. Therefore, operating costs are reduced.
5. Sprays, when in operation, not only free the air of dust, but also remove bacteria and other micro-organisms.
6. In the winter, when the sprays are shut down, ultra-violet rays having great sterilizing power are substituted for the sprays as protection against bacteria and other micro-organisms.
7. Water sprays humidify without window condensation.
8. Water sprays act as stabilizing influence on temperature and humidity, regardless of passenger load and other heat load influences.
9. Uncertainty of temperature and humidity conditions, ordinarily caused by laxity in making proper control settings, greatly reduced.
10. Only *slightly* higher in cost over conventional coil type units.



Interior and exterior views of Bangor and Aroostook coach.

Sturtevant "Railvane" Spray Type Air-Conditioning Unit.

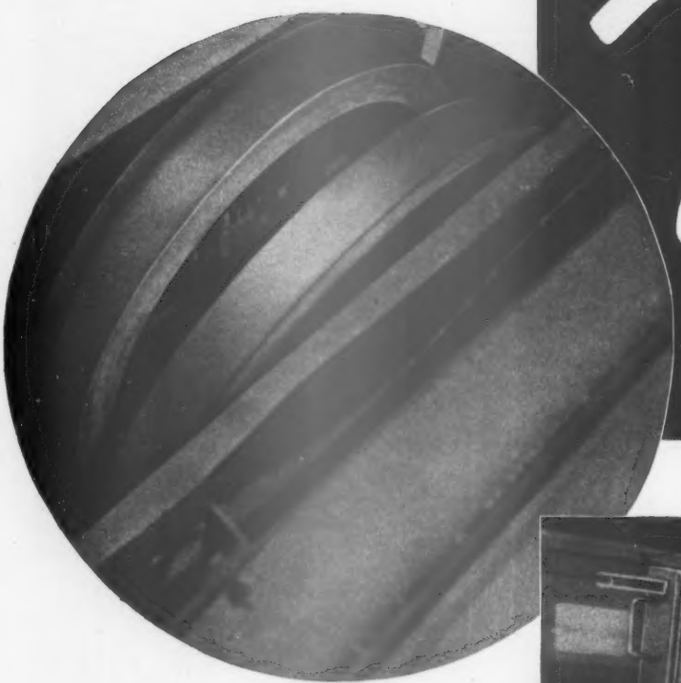
Sturtevant RAIL VANE TRADE MARK

Sturtevant "Railvane" Units or Systems are used by 37 railroads. "Railvane" Air Conditioning is protected by 30 issued patents and other patents pending.

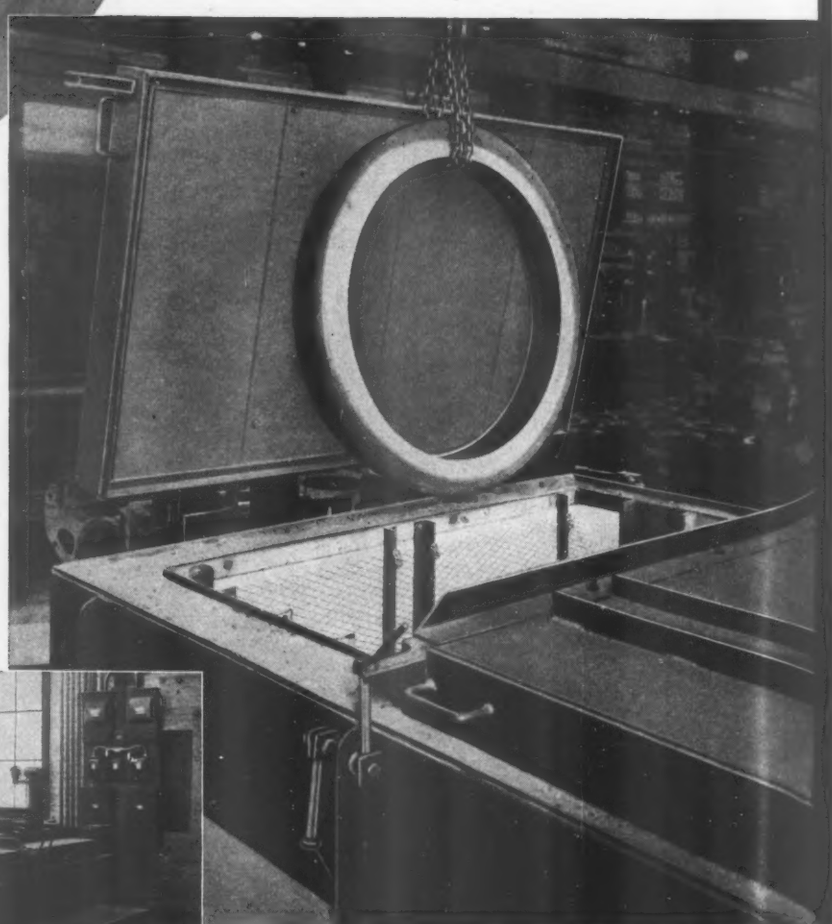
B. F. STURTEVANT COMPANY, HYDE PARK, BOSTON, MASS.

Branches in 40 Cities • B. F. Sturtevant Company of Canada, Ltd. Galt, Toronto, Montreal

More



Two tires in one compartment of the oven



90-kw tire-expanding oven used in the plant of a leading locomotive builder

Trailer wheel being lowered into one compartment of the oven

GENERAL

Photo. Courtesy Buick Motor Company

Machining operation on driving unit involving multiple diameters. Material: Forging S.A.E. 4640, Brinell 187-207. Operations: Chamfer I.D. 4.429" with V-R, Grade E, (A in photograph) while boring double diameter (.740"-.790") with H.S. Steel (B in photograph). Performance of V-R, Grade E:

Tool Material	Feed	Depth of Cut	Speed	Pieces per Grind
V-R Grade E	.0035"	1/8	340 S.F.M.	800

Every shop man knows the problem involved in machining multiple diameters in a single operation.

Here, again, Vascoloy-Ramet, the tantalum carbide tool material, demonstrates its superiority as a time and money saver, by its efficient operation at the high speed (340 S.F.M.) on the 4.429" diameter necessitated by a satisfactory boring speed on the .740" diameter.

Produced in 17 standard grades of different tantalum carbide content, strength and hardness, V-R alone covers the entire range of machinable materials and machining needs.

It is unrivaled in the machining of all steels from the softest to the toughest alloys. Its performance on cast iron, semi-steel and non-ferrous metals is exceptional.

"A Grade for Every Use" may be the solution to the machining problems in your plant. Send for the V-R Catalog price list.

VANADIUM-ALLOYS STEEL CO.
VASCOLOY-RAMET DIVISION, NORTH CHICAGO, ILL.

VASCOLOY-RAMET BLANKS

Vascoloy-Ramet is available in three forms, (a) completely finished tools, (b) milled and brazed tools, and (c) blanks. V-R blanks are furnished in 5 standard styles and in sizes to meet every requirement. To make tools with V-R blanks is a simple operation, fully described in a new instruction booklet, available free—upon request.

VASCOLOY-RAMET

. . . The TANTALUM CARBIDE TOOL MATERIAL . . .

A GRADE FOR EVERY USE

District Sales Offices:

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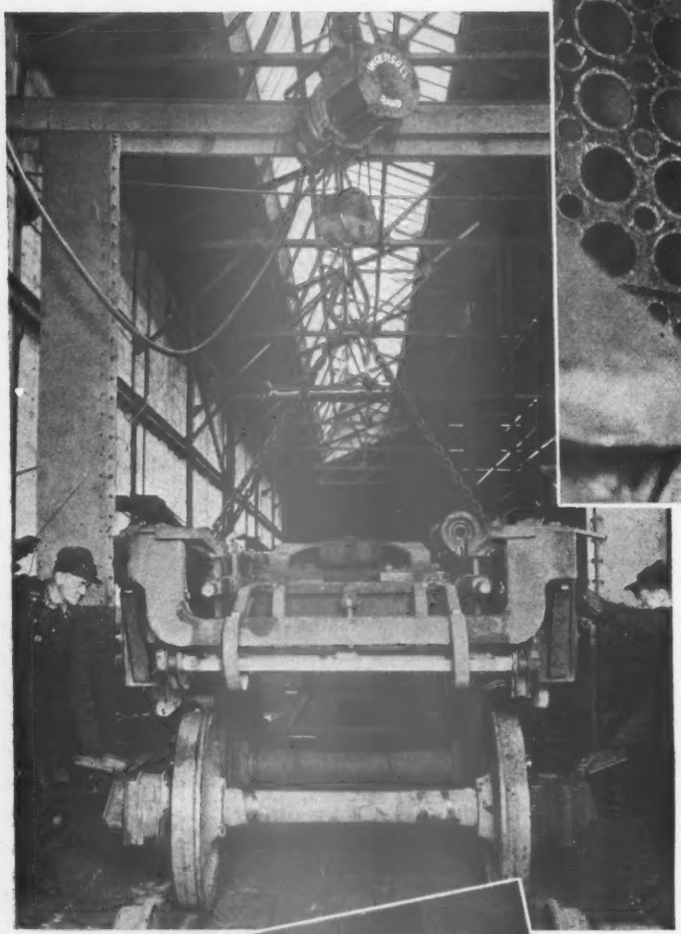

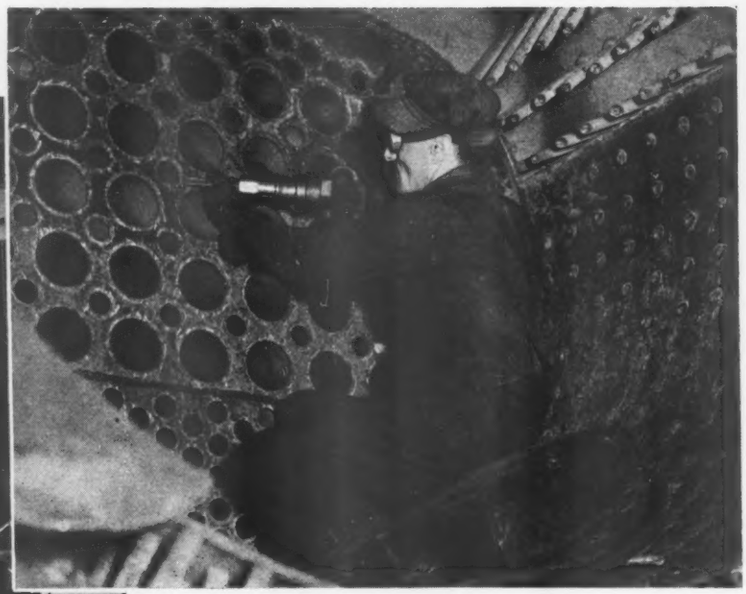

MAXIMUM RESULTS *at* MINIMUM COST—

PNEUMATIC TOOLS

THE powerful Ingersoll-Rand Impact Wrench is a "wow" in removing frozen staybolt caps and corroded nuts—gets 'em when other wrenches fail.

The I-R Safety Air Hoist equipped with automatic up and down stops assures safety to operators and helps to speed up shop operations.

The I-R chipping, calking and scaling hammers are light in weight, fast running and high powered, producing better work with less fatigue.

When your shop is equipped with low air consumption Ingersoll-Rand Pneumatic Tools, you are assured of better work and a saving in time in every operation. These cost-cutting tools are proving their worth every day in hundreds of railroad shops through the country. Let us send you full particulars. 578-8

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The part we can't show in our catalogue

You who know machinery expect modern design and fine materials in a Warner & Swasey Turret Lathe. We scarcely need mention them. But there is something far more important—something difficult to describe—that only those who have used Warner & Swaseys can evaluate. That is the *character* built into these machines; a character that pays big dividends to the turret lathe user.

For 57 years we have believed that our customer has the right to more profit out of our machine than we have. We believe you must be entirely satisfied with your purchase—not only while the machine is new but for years. We believe that unless our product fills an actual need in your plant, you should not buy it.

These ideals do pay dividends to the user, in years of trouble-free, profitable operation, little or no upkeep, less down-time and scrap loss, greater output, greater accuracy, less effort for operators. *These* are the dividends of character in a turret lathe.

WARNER & SWASEY
Turret Lathes
Cleveland

I CAN TURN IT BETTER, FASTER, FOR LESS—WITH A WARNER & SWASEY

VE BLUSH . . . *but we like it!*

n a publication's Central West- Manager:

hat Makes Main Street?' . . . is of the most outstanding and ue ways of telling a story on s that has ever been presented."

n the Vice-President of national e publication:

innovation towards the 'lighter h' . . . made me read thirstily cover to cover."

n an Editor who admits he's ervative:

re sure we have never seen a of machines so attractively de- ed and displayed . . . we are tily in accord with your attempt ject a bit of lightness into the tionally staid and stuffy selling of the machine tool industry."

From Director of copy and plans of one of America's largest steel mills:

"Sincerely, it is the finest piece of advertising that has crossed my desk this year."

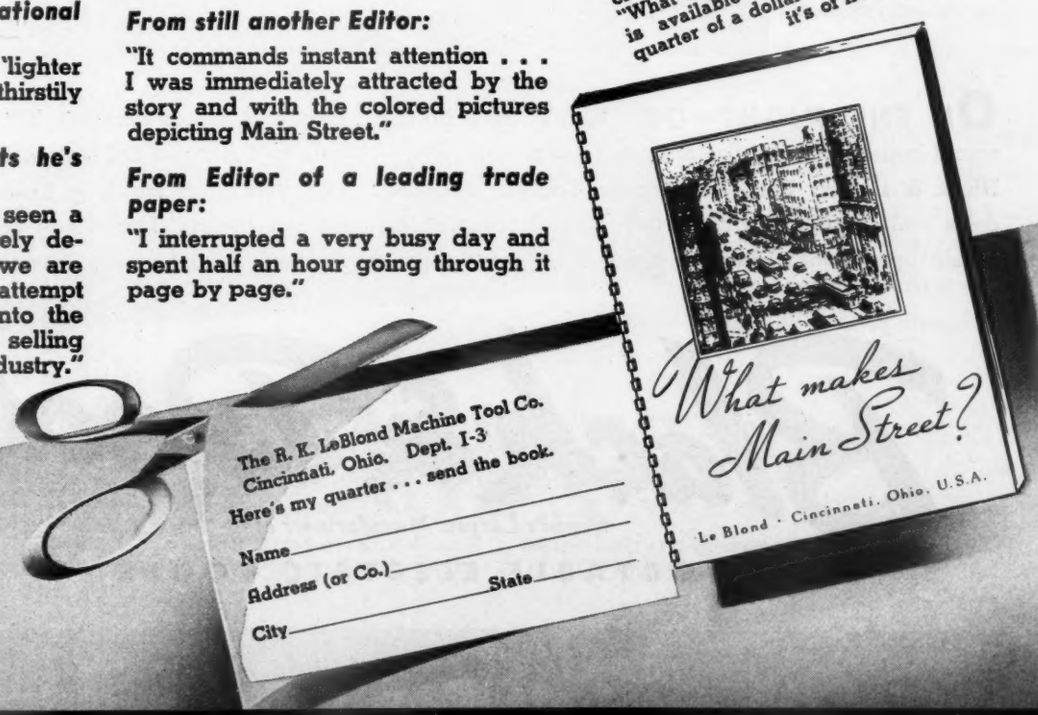
From still another Editor:

"It commands instant attention . . . I was immediately attracted by the story and with the colored pictures depicting Main Street."

From Editor of a leading trade paper:

"I interrupted a very busy day and spent half an hour going through it page by page."

Ever get patted on the back by captains of industry and bigwigs of the press? We've just had that thrill . . . the rip- pling roars of verbal applause, the flood of favorable comment that has greeted "What Makes Main Street?" Your copy is available via the coupon with a quarter of a dollar—back with interest if it's of no interest to you.



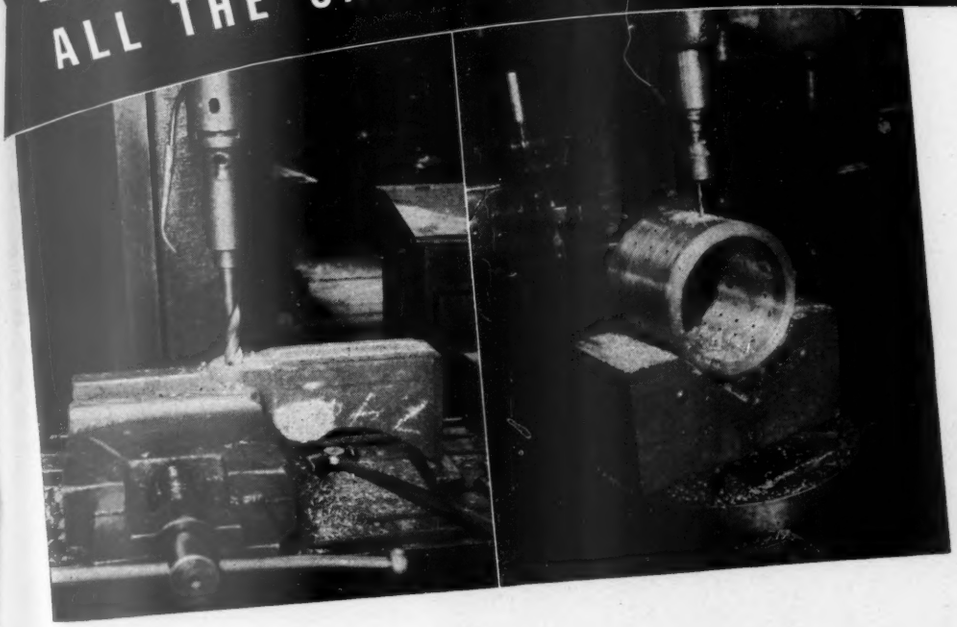
PROGRESS

IN MANUFACTURING DRILLS AND REAMERS

★ Drilling a drawbar correctly takes a well-trained mechanic and an equally dependable tool in the spindle.

★ There's where "Cleveland" Twist Drills come in—there, and in many other important operations that govern the power, speed and safety of engines that pull trains.

DRAW BAR • MAIN ROD • TRUCK PEDESTAL • BRASS BUSHING
EACH A *"Different"* DRILLING OPERATION BUT
ALL THE SAME TO "CLEVELAND"!



★ In their outstanding programs of modernizing for better, faster and lower-cost transportation of passengers and freight, many important roads have bought heavily of "Cleveland" Tools to reduce costs at the logical beginning point.

★ If you are not already using "Cleveland" Tools, why not set them to work on one of your toughest jobs? A Representative from nearby will gladly cooperate.

The CLEVELAND TWIST DRILL COMPANY
1242 EAST 49th STREET
CLEVELAND

TRADE MARK REG. U S PAT OFF AND FOREIGN COUNTRIES

30 READE ST. NEW YORK · 9 NORTH JEFFERSON ST. CHICAGO · 654 HOWARD ST. SAN FRANCISCO
6515 SECOND BLVD., DETROIT · LONDON - E. P. BARRUS, LTD. - 35-36-37 UPPER THAMES ST., E.C.4

"CLEVELAND" DISTRIBUTORS EVERYWHERE ARE READY TO SERVE YOU

BARBER STABILIZED TRUCKS

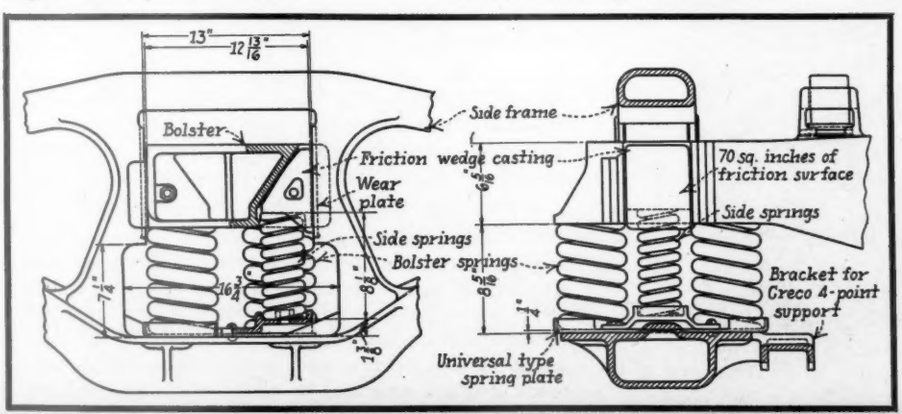
ELIMINATE Costly BOUNCING Action

Barber Stabilized Truck, Non Lateral Design, Using Standard Side Frame.

1— Vertical oscillation of bolster springs causes destructive bouncing action. The resulting damage, particularly to perishable commodities, annually costs large sums in damage claims—car maintenance is higher—safety decreased.

2— Barber Stabilized Trucks positively control bouncing. Spring movement is dampened in proportion to car load—increased spring capacity provided when most needed — springs never go solid, therefore breakage is eliminated.

3— Mechanically rugged — simple. Friction members act against wear plates on columns, ***eliminating all looseness between bolsters and columns*** — making higher speeds safer. Only slight change required in bolster design. For use with or without spring planks.



● **OVER 10,000 Car Sets of Stabilized Trucks in Service on 24 Railroads and Private Car Lines.**

STANDARD CAR TRUCK COMPANY
332 SOUTH MICHIGAN AVENUE CHICAGO, ILLINOIS

12 Important Mechanical Department "Meetings" for 1938

DURING the coming year, railway mechanical officers will get together regularly each month—not in person—but through the pages of ***Railway Mechanical Engineer***.

These impersonal "meetings" are highly valued, and mighty well "attended" . . . as shown by the fact that practically every important mechanical officer on the Class I railroads is a subscriber or regular reader of ***Railway Mechanical Engineer***. As the only publication devoted exclusively to the interests of mechanical officers, ***Railway Mechanical Engineer*** has become an accepted part of mechanical department activity. In fact, it is the recognized source of current information on improved methods, modern equipment, appliances and materials.

Through the advertising pages, manufacturers can "attend" the monthly "get-togethers" in ***Railway Mechanical Engineer***, with the assurance of a real welcome on the part of railway men . . . for the advertising pages are widely recognized and used as a valuable source of up-to-date information on specific products.

The advertising pages of ***Railway Mechanical Engineer*** not only aid mechanical officers in selecting materials and equipment to the best advantage, but enable manufacturers to build for their products the widespread recognition and acceptance that are essential to effective railway selling.

Railway Mechanical Engineer

FOUNDED IN 1832

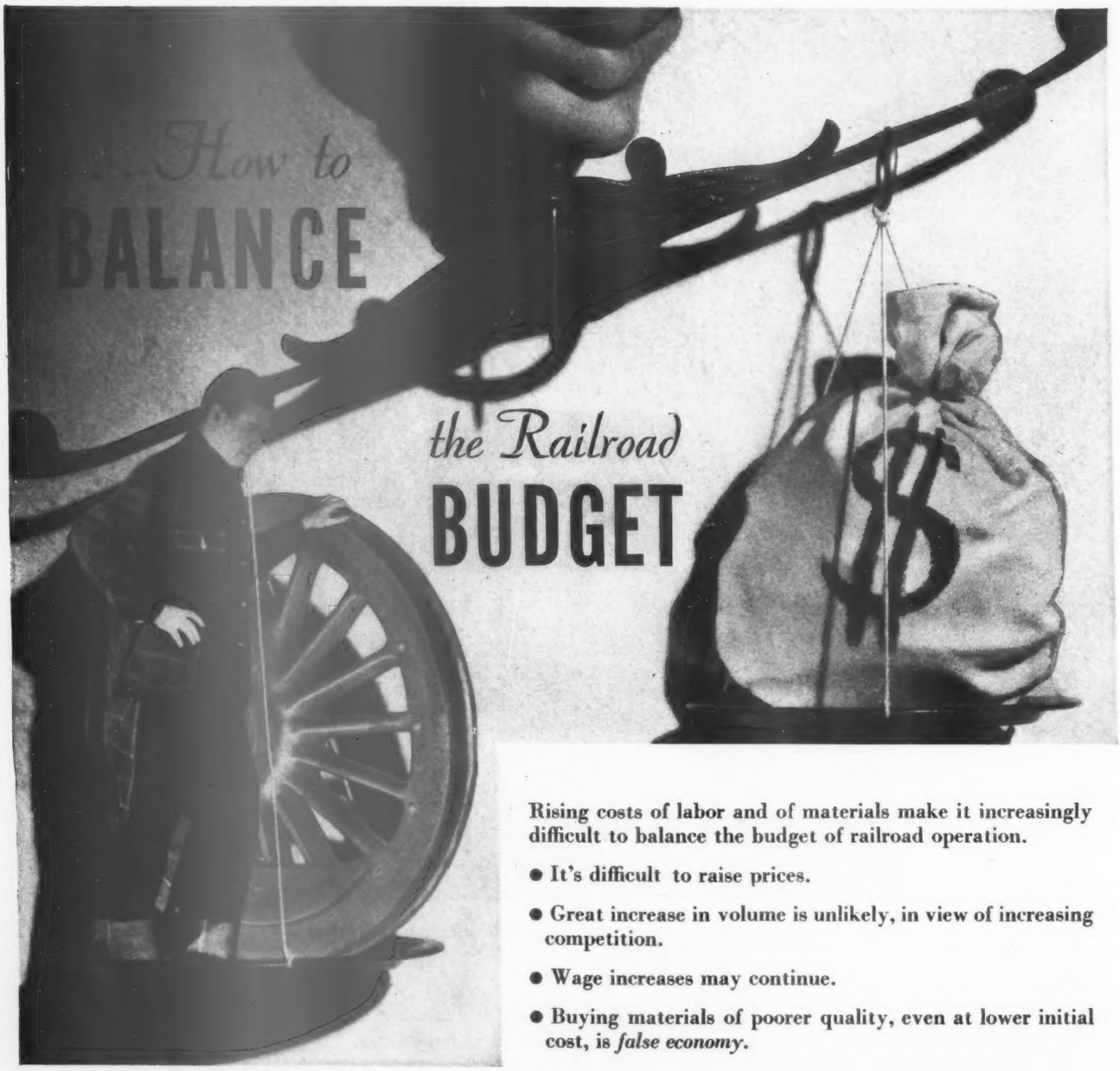
GET TOGETHER DEPARTMENT

POSITIONS OPEN POSITIONS WANTED

POSITION OPEN

MEN WANTED: Young men with railroad car department experience, to call on mechanical department officers to demonstrate and install a car and engine truck specialty. Also to service trial and permanent installations. Salary and expenses. Address Box 209, RAILWAY MECHANICAL ENGINEER, 105 West Adams St., Chicago, Illinois.

Classified Advertisements—Help and Situation Wanted advertisements appearing in the "Get Together Department," 10c a word an insertion. Minimum charge $2.00 for each insertion. For Sale advertisements $10.00 a column inch. Any number of inches may be used. Copy must be in this office by the 10th of each month preceding to insure insertion in the issue.



Rising costs of labor and of materials make it increasingly difficult to balance the budget of railroad operation.

- It's difficult to raise prices.
- Great increase in volume is unlikely, in view of increasing competition.
- Wage increases may continue.
- Buying materials of poorer quality, even at lower initial cost, is *false economy*.

THE ONLY SOLUTION IS GREATER OPERATING EFFICIENCY!

EX-CELL-O

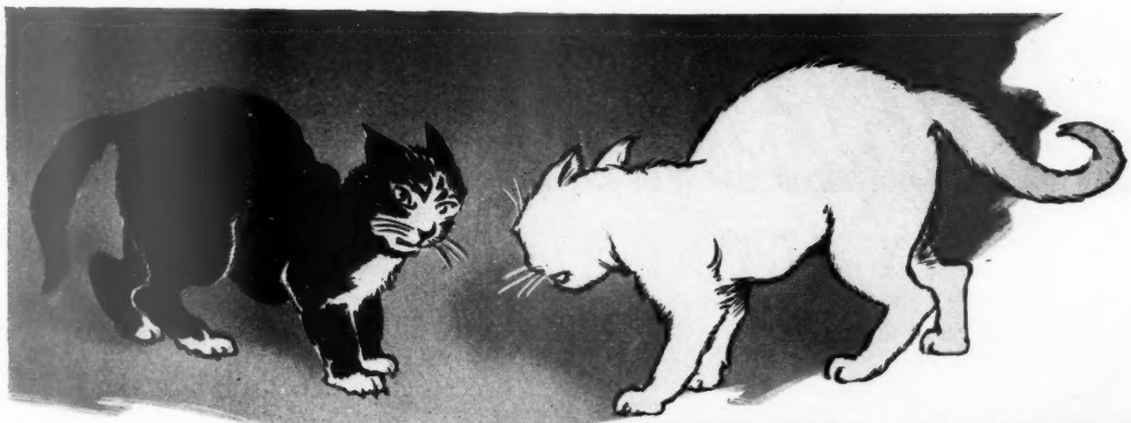
HARDENED AND GROUND STEEL

RAILROAD PINS AND BUSHINGS

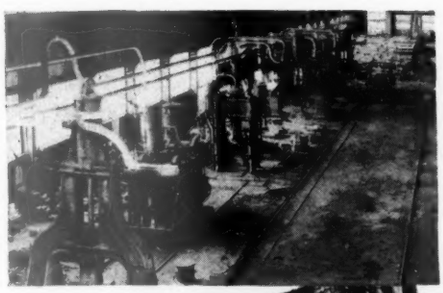
Of course, Ex-Cell-O can't balance your budget. We can't even promise to reduce your total cost of operation. BUT we offer products that will give you *more miles per dollar.* Ex-Cell-O Pins and Bushings reduce maintenance cost in these three ways:

1. Reduce running repair.
2. More mileage between shoppings.
3. Longer life of parts to which they are applied.

If yours is not one of the 80 railroads taking advantage of these savings, we urge you to get in touch with your Ex-Cell-O representative. Ex-Cell-O Corporation, 1226 Oakman Blvd., Detroit.



A DIFFERENT BREED of CATS...

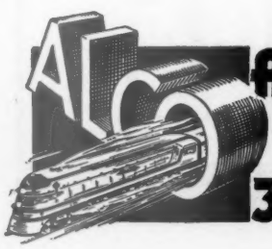


YOU cannot throw the manufacture of light-weight alloy steel forgings into the ordinary forge shop. They've got to be handled entirely differently. They're a different "breed of cats". A new manufacturing set-up is necessary—the purchase of a wide variety of particular equipment becomes imperative—the training of a special personnel essential.

Alco has this set-up, experienced and proved competent.

Why should a railroad make large capital expenditures to duplicate Alco's facilities, train a special personnel, and then work it only part time?

Alco is fully equipped in every respect to make prompt delivery, and economically as well as satisfactorily fulfill your requirements.



AMERICAN LOCOMOTIVE COMPANY

30 CHURCH STREET · NEW YORK · N·Y

PACEMAKERS

IN ECONOMICAL EFFICIENCY

BARCO TYTAMPERS

make available high efficiency mechanical tampers that eliminate heavy auxiliary equipment, reduce operating costs, prevent interference in train operation, and are surprisingly inexpensive to purchase and maintain. Standardize on BARCO Tytampers for efficient and economical tamping equipment.

BARCO

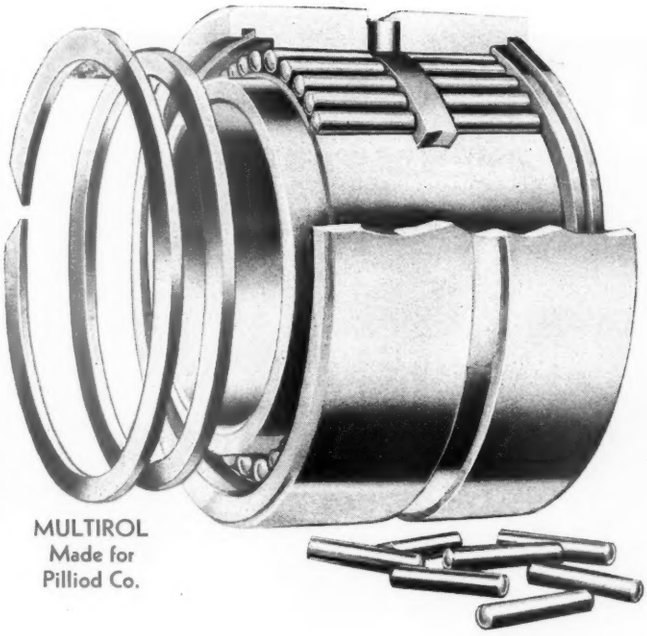
AMERICAN Railroads are setting new high standards of performance taxing mechanical equipment to new limits.

BARCO Devices are designed and built to meet these requirements—combining satisfactory service with low cost of maintenance.

BARCO MANUFACTURING CO.
1811 W. WINNEMAC AVE. CHICAGO, ILL.

In Canada
THE HOLDEN CO., LTD.
Montreal — Moncton — Toronto — Winnipeg — Vancouver

BARCO Flexible Joints | Type 3-V Engine Tender Connection | BARCO Low Water Alarm | Power Reverse Gear | Metallic Car Steam Heat Connection



MULTIROL
Made for
Pilliod Co.

Maintain Your Locomotive Efficiency and Steam Distribution

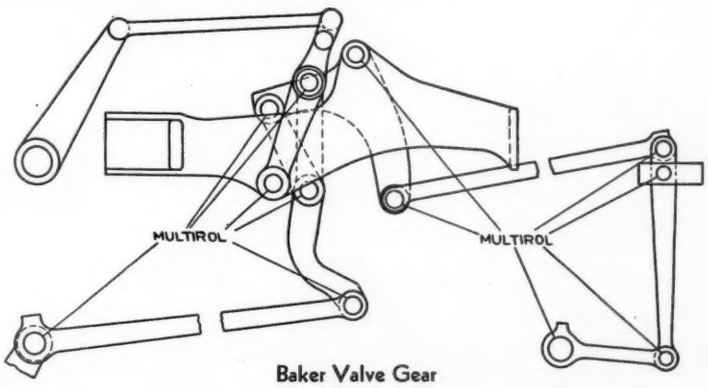
By Equipping Your Valve Gears with

McGILL
MULTIROL
PRECISION ROLLER BEARINGS

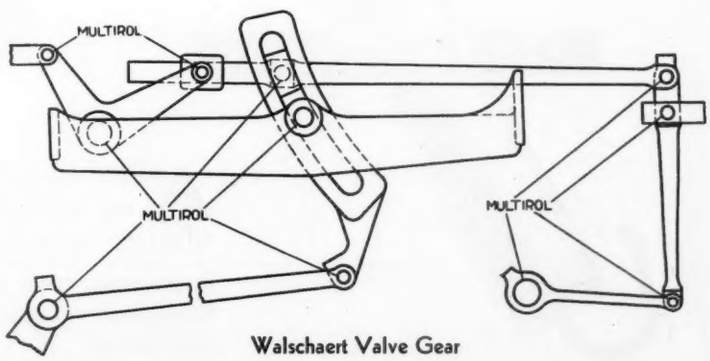
One definite way to make immediate improvements in the efficiency of your locomotives, and at the same time make immediate reductions in maintenance costs, is through the installation of McGill MULTIROL Bearings in your valve gear. These benefits are already being demonstrated in many locomotives right now.

Since their introduction eight years ago, MULTIROL Bearings have been making constant alignment possible in valve gear. They assure permanent valve setting. They cut down the number of bearing replacements necessary. They reduce the time previously required for servicing, oiling and greasing.

Find out how easily, quickly and inexpensively these improvements can be made—how much you can expect—and what others are doing through use of McGill MULTIROL Bearings, the original needle type. Write today.



Baker Valve Gear



Walschaert Valve Gear

THE PILLIOD COMPANY

Railway Representatives for McGILL *Precision Bearings*

FACTORY: Swanton, Ohio NEW YORK: 30 Church St. CHICAGO: 310 S. Michigan

62% Return on the Investment

APPLICATIONS of the *Two Piece Assemblage* and use of the *Electrical Method* of testing staybolts are effecting big savings on many roads.

Inspection costs are reduced 80% and time at least 60%. Reduction of out-of-service time has resulted in additional economies.

FLANNERY BOLT COMPANY

BRIDGEVILLE, PENNA.

PRODUCT OF THE *Rolling Mill* . . .

U·S·S LOCOMOTIVE FRAMES

To insure the greatest possible homogeneity and strength, the steel for U·S·S Frames is converted from ingots into slabs by two separate rollings. Seams and small surface imperfections are removed between rolling operations and sufficient discard is taken from each ingot and slab to secure freedom from piping and undue segregation. Prior to the gas cutting operation, slab is heated and rectified for flatness, then held at approximately 400° to 600° F. during the entire torch-cutting operation and until placed in the normalizing furnace.

Torch-cut in one continuous piece from a solid steel slab, uniform in strength from end to end

IT'S the steel—wrought and rolled carbon steel with high and uniform physical properties throughout — that makes U·S·S Locomotive Frames much stronger, tougher, more shock-resistant.

Rolled steel is the secret of their greater factor of safety. Rolled steel in this vital part of the locomotive removes the source of failure . . . saves shopping for cracked and failed frames . . . reduces maintenance costs . . . keeps your motive power on the road available for service.

Check over these outstanding advantages—

Low First Cost, **especially where only a few locomotives are built, or when cylinders or frames are renewed — because no expensive patterns or molds are necessary.**

Low Maintenance Charges **throughout the life of the locomotive . . . due to the practical elimination of repairs and renewals on account of cracking.**

Less Weight**—due to the fact that the superior physical qualities of rolled steel make it possible to reduce sections with safety.**

Freedom from Imperfections Throughout, **absence of trapped stresses or blow holes assured by the inherent superiority of rolled steel possessing a high degree of homogeneity.**

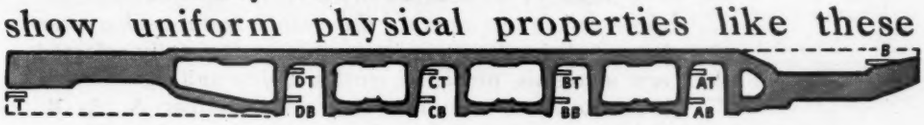
Greater Flexibility **to safely absorb shocks, impacts, weave vibration.**

Greater Margin of Safety **and durability.**

Ease of Installation **of part-frame sections when existing frames are renewed or repaired.**

When new locomotives or major repairs are under consideration, discuss these points with our engineers.

Only ROLLED STEEL can show uniform physical properties like these



A recent test made from the "cut out" material of a carbon steel U·S·S Side Frame, selected at random, showed the following properties:—

NOTE. **Higher physical properties, if desired, can be obtained in U·S·S Wrought Steel Side frames by the use of nickel or vanadium alloys.**

Test	Yield Point	Tensile Strength	Per Cent Elongation	Per Cent Reduction of Area
B	44530	79580	37.0	57.4
AT	41830	79580	33.0	58.6
AB	43930	79880	29.0	53.4
BT	44030	82280	30.0	54.7
BB	44530	83230	31.0	54.7
CT	44030	82080	31.0	56.1
CB	42280	83080	30.5	56.1
DT	43330	79880	29.0	53.4
DB	44480	81480	30.0	54.7
T	43480	80980	29.0	53.3

CARNEGIE-ILLINOIS STEEL CORPORATION

Pittsburgh *Chicago*

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

LUNKENHEIMER
A.A.R. VALVES
for
Locomotives

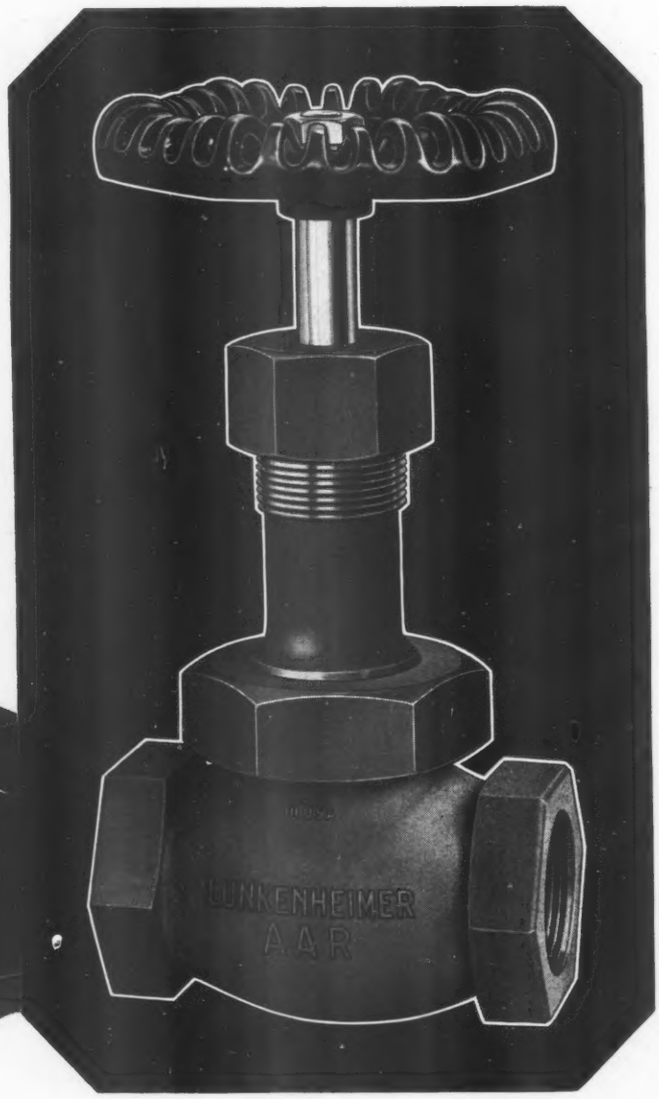


Fig. 1890
Inside Screw

Made in accordance with A. A. R. specifications, these valves also embody the quality features characteristic of all Lunkenheimer products. Carefully selected raw materials, precision workmanship and rigid testing procedure are reasons why Lunkenheimer A. A. R. Valves so successfully withstand the severity of locomotive service.

Available in inside and outside screw patterns, globe and angle, and with male or female inlet, union outlet connections. All patterns are made in both full-way and plug type.

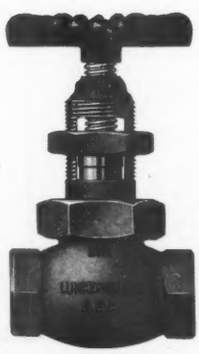


Fig. 1896
Outside Screw

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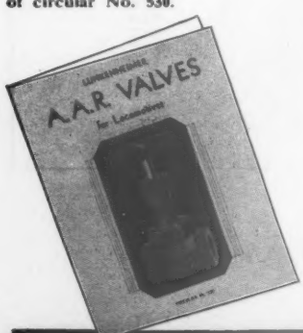

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UNITED STATES STEEL

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